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Is there a developmental progression to phonological awareness?: a look at bilingual and monolingual beginning readers.

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IS THERE A DEVELOPMENTAL PROGRESSION TO PHONOLOGICAL AWARENESS?: A LOOK AT BILINGUAL AND MONOLINGUAL BEGINNING READERS

A Thesis Presented

by

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ABSTRACT

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The purpose of the present study was to examine whether phonological awareness skills develop in a systematic fashion. English-speaking first grade students in mainstream classrooms and Spanish-speaking first grade students in Transitional Bilingual Education (TBE) classrooms were given rhyme detection, initial phoneme detection, and final phoneme detection tasks in both English and Spanish. Mainstream and TBE kindergarten students were given the above tasks only in their native language. Students were tested initially in December and again in May.

The study tested the developmental progression hypothesis which proposed that the development of phonological awareness skills proceeds from rhyme awareness to onset (initial phoneme) awareness, to phoneme awareness, and that phonological awareness skills that are least developed improve the most over time. Analyses were performed separately for the mainstream and TBE groups on accuracy and response time data. The results of mainstream

analyses showed that the ability to detect rhyme developed first. A systematic order of initial phoneme and final phoneme detection skills was not clear from accuracy data, but response time data indicated that ability to detect initial phonemes may be developing first. The results of the TBE analyses did not indicate a developmental progression of phonological awareness skills. However, in an additional analysis comparing the performance of mainstream and TBE students on their native language phonological awareness tasks, it was found that TBE first grade students made substantially greater gains on native language phonological awareness tasks than did mainstream first grade students. This result was interpreted as supportive of the prediction specified by the developmental progression hypothesis that the least developed skills improve the most.

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CHAPTER 1

INTRODUCTION

One of the central goals of researchers and educators interested in reading is to understand why some children become good readers and others poor readers. There is substantial evidence that differences between older good and poor readers have their origins in differences between very young readers. Several authors have described the developmental origin of good and poor reading as "Matthew effects" (Stanovich, 1986). Matthew effects refers to a rich-get-richer-poor-get-poorer phenomenon whereby early achievement produces faster rates of subsequent achievement and early difficulty delays progress. For instance, children who read well will read more, build their vocabularies, and thus read even better. For those who read poorly, frustrating reading experiences cause them to read less, which inhibits further growth in their reading skills. The impact of Matthew effects is illustrated vividly by the observation of Nagy and Anderson (1984) that the least motivated child in the middle grades might read 100,000 words a year, the average child 1,000,000 words, and the voracious middle grade reader 10,000,000 to 50,000,000 words a year. Individual differences such as these have serious ramifications for performance on many academic tasks.

Ability differences exist even in beginning readers. For example, substantial individual differences in the rate

of reading simple text have been found among first grade children (Biemiller, 1970). Differences in the rate of identifying letters, of reading unrelated words, and in the rate of reading simple text have also been found in elementary grade children (Biemiller, 1977-1978). These findings suggest that some children come to school adequately prepared to learn to read while others do not.

The possibility that some children are not prepared to learn to read raises the question: What skills should children possess in order to benefit from beginning reading instruction? One skill that stands out as critical in preparing children for reading acquisition is phonological awareness: "If there is a specific cause of reading disability at all, it resides in the area of phonological awareness" (Stanovich, 1986, p. 393).

This thesis is centered around the idea that phonological awareness is an "enabling" skill for reading readiness. Phonological awareness refers to the knowledge that spoken words are made up of smaller units of sound. Awareness of word sounds enables children to develop skills required for progress in learning to read. Conversely, insufficient phonological awareness may delay or hinder the acquisition of necessary skills, producing a lag in reading achievement. The "enabling" nature of phonological awareness will first be framed within the context of a theory of reading acquisition provided by Perfetti (1990)

and will then be discussed in terms of evidence supporting a relationship between phonological awareness and subsequent reading ability.

A Theory of Reading Acquisition

The theory of reading acquisition advanced by Perfetti (1990) provides a suitable context for discussing the role of phonological awareness in learning to read. Perfetti describes reading acquisition in terms of representation. That is, he is concerned with how a child's lexical representations and access of these representations change as the child moves from a "novice" stage to an "expert" level of lexical access. A convenient place to begin a description of Perfetti's reading acquisition theory is with his description of the lexical representation system of expert readers. The discussion will then move to a description of how this representation is acquired and the importance of phonological awareness in the acquisition process.

The "Expert" Lexical Representation System

Perfetti uses a Restricted-Interactive model to illustrate "expert" lexical access. In skilled reading there are restrictions on the use of non-lexical knowledge in word identification. In other words, the lexicon allows little influence on word identification by general knowledge, context, or expectations. At the same time, word identification processes are interactive in the use of

intra-lexical information. A lexical representation contains information about a word and its constituent letters, and accessing a representation involves interactions between letters and words, letters and phonemes, and phonemes and words.

Perfetti's theory emphasizes the role of phonological knowledge in skilled lexical access, unlike the direct access view (word accessed by direct orthographic input) or the phonological recoding view (word accessed by phoneme strings recoded from print). The basic claim is that phonemic information is obligatorily activated as an intrinsic part of lexical access because it is considered part of the lexical representation. Phonemic information is connected to information about both words and letters, which are both part of the lexical representations of words. This allows phonemic activation to occur in two ways: phonemes are activated by letters because of associations between letters and phonemes, and phonetic word shapes are activated by words. Whether speech codes are pre-lexical or post-lexical depends on how rapidly lexical access occurs. With unfamiliar words or unskilled readers, a high level of phonemic activation may build up and a name-code (speech code) may be activated before semantic codes are sufficiently activated. But in skilled readers the speech code is quickly accessed even though some semantic codes may be activated before the speech code. Nevertheless, the fact

that phonemic information is part of a word's lexical representation and is accessed obligatorily during lexical access makes the role of phonological knowledge in skilled reading critical.

Acquisition of the "Expert" Lexicon

Having established the importance of phonological information in "expert" lexical access, it is now appropriate to consider how phonological knowledge and information is involved in the acquisition of lexical expertise.

Perfetti attributes a major portion of the development of reading skill to the acquisition of individual word representations. To explain this acquisition, he uses a dual-mechanism learning model. This model is analogous to the dual-route model of lexical access, which proposes an indirect recoding route and a direct orthographic route (e.g., Rayner & Pollatsek, 1989). According to the dual-mechanism model, the acquisition of new lexical representations is determined by two mechanisms: one based on specific pattern-learning and the other based on decoding rules that are gradually acquired and expanded. In the specific pattern-learning mechanism, word representations are acquired by learning a specific pattern of letters corresponding to a word. This mechanism results in the acquisition of "sight words" (words that are recognized as holistic patterns). The decoding mechanism, which utilizes

rules associating letters and phonemes, is involved in the use of decoding, or "sounding out," activities in acquiring word representations.

The decoding mechanism is where phonemic knowledge plays a role in the acquisition of a functional lexicon. The decoding mechanism operates on grapheme-phoneme rules. This requires that some rudimentary connections between phonemes and their corresponding letters be present. Although these connections are weak and unstable at first, they nonetheless serve as an aid to learning new words by enabling the child to decode print into sound. As experience and practice with print increases, the decoding rules become stronger and less variable. This allows the child to be able to acquire even more lexical entries. In other words, the decoding mechanism is responsible for the potential number of entries that a child is able to acquire, even though both the specific pattern-learning and decoding mechanisms are responsible for the actual number of entries acquired.

In addition to increasing the number of lexical entries, the quality of lexical representations must be improved in order to achieve a functional lexicon. Quality is characterized by principles of precision and redundancy. Precise representations are ones that are fully specified. Fully specified representations rely less on context and allow a given letter string (and its associated phonemes) to

be sufficient in activating a word. In contrast, a variable representation includes free variables where the precise representation includes specific letters.

Redundancy, the second of the principles determining the quality of lexical representations, refers to the inclusion of redundant information sources. The main source of redundancy is the overlap of information between letters and phonemes. Redundant lexical representations are important for both identification of unfamiliar words and rapid, automatic recognition of familiar words.

Phonemic knowledge, according to Perfetti (1990), is critical in both skilled reading and reading acquisition. Phonemic information is central in skilled reading because representation and activation of phonemic information is considered the heart of lexical access. The decoding mechanism is a powerful tool for acquiring reading skills because it allows a child to use and expand information about phonemes and their corresponding letters in order to acquire more and more lexical representations.

Although phonemic knowledge is critical to the acquisition of reading skill, there is yet another skill that is critical to the acquisition of phonemic knowledge. This skill, which involves the ability to decompose speech sounds into phonemic units, is known as phonological awareness.

Phonological Awareness Enables Reading Acquisition

According to Perfetti (1990), phonemic information is important for reading and reading acquisition. Before phonemic information is represented in the lexicon, though, a child needs to become aware that spoken words are made up of smaller and smaller units of sound, the smallest being phonemes. The awareness that words can be broken into units of sound is known as phonological awareness. The development of phonological awareness, then, serves to enable reading acquisition.

Phonological awareness is an enabling skill because it is a necessary but not a sufficient condition for the acquisition of reading skills. Children who are not phonologically aware may be able to learn to read, but the acquisition of reading skill is likely to be greatly delayed. It is also the case that children who are phonologically aware are not guaranteed of mastering beginning reading skills, although they may generally have less difficulty than those who are not phonologically aware.

The characterization of phonological awareness as a necessary but not sufficient skill for reading acquisition is consistent with Perfetti's (1990) notion of phonological awareness. Perfetti claims that rudimentary phonemic knowledge, meaning knowledge of the sounds of a few letters, is causally necessary for progress in reading. Although rudimentary phonemic knowledge is necessary, Perfetti argues

that this knowledge should not be considered a prerequisite since assigning a prerequisite status to a skill implies that it *must* be achieved before progress is made.

In Perfetti's theory of the acquisition of word representations, phonemic knowledge plays a critical role in both skilled reading and reading acquisition. Phonological awareness serves to enable reading acquisition because the development of some minimal level of phonological awareness, in the form of an ability to recognize the sounds of some letters, initiates the acquisition of phonemic knowledge that is so critical for acquiring new word representations. In a later section, empirical evidence will be discussed that supports the notion of phonological awareness as an enabling skill for reading acquisition. Before the evidence is reviewed, however, it is necessary to clarify what exactly phonological awareness is.

What Is Meant by Phonological Awareness?

In the above discussion of the importance of phonological awareness for reading, *phonological awareness* was specified by Perfetti as knowledge of the sounds of some letters. Specifically, Perfetti uses *phonological awareness* to refer to rudimentary (or computational) phonemic knowledge. Children with rudimentary phonemic knowledge have acquired weak, unstable connections between phonemes and letters. These connections may be nothing more than knowledge of some letter names.

According to Perfetti, computational knowledge is different from "phonemic awareness," which he refers to as a more explicit, reflective phonemic knowledge. Phonemic awareness is considered to be explicit because it develops from experience with print and discovery of the alphabetic principle (knowledge that print is comprised of meaningless units of speech).

Outside the context of Perfetti's theory, the term phonological awareness has a broader interpretation than that of rudimentary phonemic knowledge. Phonological awareness is generally used as a blanket term that encompasses several forms of awareness. There are several forms of phonological awareness because there are several ways of segmenting words into sounds (Goswami & Bryant, 1990). First, words can be broken into syllables, the largest units of sound. Second, each syllable of a word or each monosyllabic word can be decomposed into two units called onset and rime. An onset is the initial phoneme or phonemes corresponding to the beginning consonant or consonant cluster and the rime is comprised of the vowel and remaining sounds. Finally, words can be segmented into their individual phonemes, the smallest units of sound.

The discussion of phonological awareness in this thesis uses *phonological awareness* as a blanket term referring to several different forms of awareness. Because the various forms of phonological awareness are critical for further

discussion of phonological awareness as an enabling skill, a brief explanation of the forms of phonological awareness and the various tasks that assess each form of awareness follows.

Syllable Awareness

Syllable awareness is an elementary level of phonological awareness. Breaking words into syllables is relatively easy for very young children. A child's awareness of syllables, however, is not strongly predictive of progress in beginning reading instruction. The reason may be that many of the words that children first learn to read are monosyllabic. However, syllable awareness may be related to progress in later reading when multisyllabic words are acquired.

Syllable Awareness Tasks. Phonological awareness tasks that tap syllable awareness are syllable counting and syllable detection (or word-to-word matching of syllables). Syllable counting tasks require a child to count the number of syllables in a word. Syllable detection tasks require a child to determine whether two words share the same syllable (either initial or final syllable).

Onset-Rime Awareness

An intermediate level of phonological awareness is awareness of intrasyllabic units that are smaller than the syllable but larger than the phoneme. These units are called "onset" and "rime." The onset is the initial phoneme

(or phonemes if the onset is a consonant cluster). The rime is the end sound, consisting of the vowel and the remaining consonant sounds. For example, "-at" is the rime for words like "bat," "cat," and "sat." Hence the rime is appropriately named because words rhyme when they share a common rime (Goswami & Bryant, 1990). Since words with the same rime unit rhyme, it is possible that onset-rime awareness is preceded by a more basic awareness called "rhyme awareness." When children become sensitive to rhymes, they begin to realize that rhyming words share the same sounds, namely the rime. Upon this realization, they are able to recognize implicitly that rhyming words share rimes but not onsets. Hence, the level of onset-rime awareness.

Rhyme (Rime) Awareness Tasks. Tasks that assess awareness of rimes (rhymes) are rhyme production and rhyme detection. Rhyme production tasks require a child to produce a rhyming word in response to a target. Rhyme detection tasks require a child to identify whether or not a pair of words rhyme.

Onset (Initial Sound) Awareness Tasks. Onset awareness is assessed by the initial sound subtask of the oddity task and the word-to-word matching task. Oddity and word-to-word matching tasks, which consist of a subtask for each phoneme position of a word (i.e. initial, medial, and final), require a child to recognize similarities and differences

between words. In word-to-word matching of initial sounds, a child must distinguish whether two words have similar beginning sounds. In oddity tasks a child must distinguish the odd word from a list of three or four words that share an initial sound.

Phonemic Awareness

Phonemic awareness refers to the knowledge that words consist of individual phonemes, which are the smallest units of sound that can change the meaning of a word. For example, "sat" and "mat" have different meanings because they differ by one phoneme, the initial "s" or "m" sound. Phonemic awareness is the most sophisticated form of awareness because it generally develops from, or at least alongside, initial experience with print, either in the form of being read to or learning to read. Children without print experience are usually not aware that words are represented by a string of individual phonemes. The reason for this difficulty stems from the lack of segmentation of phonemes in speech (Liberman & Liberman, 1990). Each phoneme is not produced or perceived in isolation, but rather in the context of the preceding and following phonemes (Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). The word "bat," for example, is not heard as /b/ /a/ /t/, but as one unit. Even in an attempt to say /b/ in isolation, there is still a vowel sound attached called the schwa vowel so that "b" would sound like "buh."

Phonemic Awareness Tasks. Some phonemic awareness tasks require explicit phoneme manipulations. These tasks are: segmenting a word into phoneme (phoneme segmentation), blending individual phonemes to make a word (blending), reversing the order of phonemes in a word (phoneme reversal), and deleting one or more phonemes of a word (phoneme deletion).

However, other phonemic awareness tasks, such as word-to-word matching and oddity tasks, only require the ability to recognize similarities and differences between words in terms of phonemes in various positions. In oddity tasks a child must distinguish the odd word from a list of three or four words that share initial, medial, or final phonemes. In word-to-word matching tasks a child must determine whether two words share an initial, medial, or final phoneme. Although the initial sound subtask of the oddity and word-to-word matching tasks can serve as a measure of onset awareness, all three subtasks together would serve as a measure of phonemic awareness since the ability to recognize similarities (or differences) in every phoneme position would indicate that a child has knowledge of words as consisting of individual phonemes.

Summary

Phonological awareness refers to several different types of awareness. Each form of phonological awareness can be said to enable the development of reading skills.

However, there has been much disagreement in the literature concerning the influence each of the forms of phonological awareness has on learning to read. The next section reviews three models that suggest different relationships between the forms of phonological awareness and reading acquisition.

Models Relating Phonological Awareness to Reading

It is apparent from the above discussion of the forms of phonological awareness that phonemic awareness is most closely linked to learning letter-sound correspondences and learning to read. It is a knowledge that individual phonemes comprise words, which develops from or alongside experience with print. However, many would argue that other forms of phonological awareness, such as those described in the preceding section, are also important for enabling reading acquisition. There has been much debate in the literature concerning the influence that each of the forms of phonological awareness has on beginning reading achievement. Three models of the relationship between phonological awareness skills and beginning reading have been proposed. A brief discussion of these models are presented below.

The Reciprocal Model

The first model will be referred to as the reciprocal model because the relationship it suggests between reading and phonemic awareness is one of mutual influence. The reciprocal model claims that initial experience in learning

to read influences the child's awareness of phonemes, and increasing awareness of phonemes subsequently affects the child's reading ability. This view does not indicate any particular relation between phonemic awareness and more basic phonological skills, such as awareness of onsets and rimes or syllable awareness. The reciprocal model also does not specify a connection between more basic phonological skills and learning to read. In fact, the proponents of this model (e.g., Morais, Bertelson, Cary, & Alegria, 1986; Morais, Alegria, & Content, 1987) have claimed that simpler forms of phonological awareness, such as rhyme, have nothing to do with grapheme-phoneme rules and little to do with reading. Their reason is that rhyme awareness develops naturally but phonemic awareness is a product of learning to read.

An alternative to the reciprocal model is one in which more basic forms of phonological awareness, such as awareness of rhymes, syllables, and onsets (initial sounds), play a greater role in reading acquisition. Bryant, Maclean, Bradley, and Crossland (1990) have proposed two such models.

The Indirect Influence Model

The first model that Bryant et al. (1990) have proposed will be referred to as the indirect influence model because it suggests that rhyme awareness (or sensitivity to alliteration) indirectly affects learning to read through

its influence on the development of phonemic awareness. That is, rhyme or alliteration awareness leads to phonemic awareness, which then directly affects learning to read. This model would predict a relationship between rhyme (or alliteration) awareness and later success in reading, but would predict that the relationship would disappear if individual differences in phonemic awareness are controlled.

The Direct Influence Model

The second model proposed by Bryant et al. (1990), the direct influence model, suggests that rhyme awareness (or sensitivity to alliteration) and phonemic awareness both directly affect beginning reading ability. Unlike the indirect influence model, this model would predict that the relationship between rhyme (or alliteration) sensitivity and subsequent reading success would hold even after the effects of phoneme knowledge have been controlled.

Summary of the Models

The three models reviewed in this section differ in the amount of influence that is given to each of the levels of phonological awareness. The reciprocal model only specifies the role of phonemic awareness in learning to read. Phonemic awareness in this model is similar to what Perfetti (1990) calls reflective phonemic knowledge. It is a sophisticated knowledge that words consist of individual phonemes, which comes from experience with print and learning to read. The indirect and direct influence models

indicate that phonemic awareness as well as more basic forms of phonological awareness, such as onset and rhyme awareness, influence reading acquisition. The forms of phonological awareness in these models (rhyme awareness, onset awareness, and phonemic awareness) are not products of learning to read, but instead precede reading acquisition. They are, therefore, implicit forms of phonological awareness because they only involve knowledge that words are similar or different in some respect. The only difference between the indirect and direct influence models is that rhyme and onset awareness indirectly affect beginning reading ability in the indirect influence model, but directly affect beginning reading ability in the direct influence model. The next section reviews evidence relating phonological awareness to beginning reading achievement. Research results will be discussed in light of these models.

Evidence for Phonological Awareness As an Enabling Skill

In an earlier section of this thesis, Perfetti's view of the importance of phonemic knowledge for reading acquisition and the relationship between phonemic knowledge and phonemic awareness were presented. In the immediately preceding section three possible interpretations of the relationship between phonological awareness and early reading achievement were presented. The section to follow will review the empirical evidence demonstrating the

importance of phonological awareness in the acquisition of reading skill.

Phonemic Awareness and Decoding Ability

Studies by Tunmer and Nesdale (1985) and Tunmer, Herriman, & Nesdale (1988) have provided evidence that the link between decoding skill and reading ability begins with phonemic awareness. The Tunmer and Nesdale (1985) study assessed verbal intelligence, phonemic awareness, and reading achievement of first grade students in Australia (where formal reading instruction begins later than in the United States). Phonological awareness was measured by a phoneme segmentation task, called phoneme tapping, which was developed by Liberman, Shankweiler, Fischer, & Carter (1974). In this task children tapped the number of sounds they heard in non-digraph (digraphs are two letters that represent one phoneme) words with a stick. Reading achievement was determined by three subtests of the Interactive Reading Assessment System: word decoding, pseudoword decoding, and reading comprehension. Pseudoword decoding was used as a measure of phonological recoding ability because pseudowords can only be accessed through the phonological route by transforming letter strings into sound codes.

The results indicated that reading ability of first grade children was determined in part by decoding ability. A multiple regression analysis revealed that pseudoword

decoding accounted for a significant amount of the variance in predicting reading comprehension, independent of other factors like IQ. This was consistent with other findings of individual differences in reading ability due to decoding skill (e.g., Perfetti & Hogaboam, 1975).

The Tunmer and Nesdale (1985) study also pointed to phonemic awareness as an important factor influencing decoding ability. A path analysis showed the determinant of phonological recoding ability to be phoneme segmentation ability. Moreover, a scatterplot revealed a nonlinear relationship between performance on phoneme segmentation and performance on pseudoword decoding. That is, some students performed well on the segmentation task and poorly on the decoding task, other students had either high scores or low scores on both tasks, but there were no students who did poorly on segmentation and well on decoding. The pattern indicated that the ability to segment words into phonemes may be necessary but not sufficient for the acquisition of decoding skill.

The conclusion of the Tunmer and Nesdale study that phonemic awareness is necessary but insufficient for decoding ability is supported by evidence from a longitudinal study by Tunmer, Herriman, and Nesdale (1988). Tunmer et al. (1988) replicated the results of the Tunmer and Nesdale (1985) study and provided additional evidence that phonemic awareness influences decoding ability.

Tunmer et al. (1988) administered a battery of metalinguistic tests to students beginning first grade. The battery included a test phoneme tapping of non-digraph nonwords. At the end of first grade, students were readministered the battery and were given three subtests of the Interactive Reading Assessment System (as in Tunmer & Nesdale, 1985). At the end of second grade the children received the Interactive Reading Assessment System tests again.

The results replicated the Tunmer and Nesdale (1985) study. A path analysis showed phonemic awareness to be a determinant of phonological recoding ability. Moreover, a scatterplot showing the relationship between phoneme segmentation performance and pseudoword naming revealed the same nonlinear pattern found by Tunmer and Nesdale (1985).

Tunmer et al. (1988) found additional evidence that decoding ability is influenced by phonemic awareness. When students were divided on the basis of letter-name knowledge and phonological awareness level (in terms of phoneme segmentation ability), students with high phoneme segmentation scores were markedly superior to those with low phoneme segmentation scores on the pseudoword decoding task, regardless of their level of letter knowledge. Letter knowledge served only to differentiate children in each phonological awareness group; those with high letter knowledge performed slightly better than those with low

letter knowledge. This suggested that in order to use sound-letter correspondences in decoding, some minimal level of phonemic awareness must be achieved before children can benefit from the knowledge of letter names they have.

The findings of Tunmer and Nesdale (1985) and Tunmer et al. (1988) have indicated that awareness of phonemes may enable acquisition of decoding ability. The nonlinear patterns between phoneme segmentation ability and decoding skill in Tunmer and Nesdale (1985) and Tunmer et al. (1988) suggested that phonemic awareness may be necessary but not sufficient for the development of decoding skill. Also, the results of the Tunmer et al. (1988) study demonstrated that the level of phonemic awareness differentiated good decoders from poor decoders, regardless of their level of letter knowledge. Taken together, these results suggest that children may need some minimal level of phonemic knowledge in order to make progress in developing decoding skills.

The studies reported above have provided evidence that awareness of phonemes is necessary for developing decoding skills. The acquisition of phonemic awareness and subsequent use of the decoding mechanism are important for developing reading ability because they give a child the potential to acquire a great number of word representations. Decoding skill, however, should not be equated with reading ability. Reading ability encompasses word decoding as well as the ability to read words in text and understand what was

read. The next section presents several studies that examine the relationship between phonological awareness skills and indices of reading ability other than word decoding.

Phonological Awareness and Reading Ability

The studies discussed in the previous section suggest that phonemic awareness may be necessary for developing decoding skill. Once a child develops the ability to decode unfamiliar words and acquire new word representations, he or she is able to practice reading words in text and continue the process of becoming a reader. Thus, it seems reasonable that phonological awareness would ultimately affect beginning reading ability. A number of studies using phoneme manipulation tasks have clearly illustrated a relationship between phonological awareness and reading success.

A study by Liberman, Shankweiler, Fischer, and Carter (1974) involved administering a tapping task to children in nursery school, kindergarten, and first grade (4-, 5-, and 6-year-olds) at the end of the school year. One group of children at each grade level was required to tap the number of syllables in words and the other group was required to tap the number of phonemes. The tapping task was continued through 42 test items or until children reached a criterion of successfully tapping six consecutive trials.

The results demonstrated that children at all age levels were better able to segment words into syllables than into phonemes. The data also indicated a developmental trend in phoneme segmentation ability. None of the 4-year-olds reached the criterion of six consecutive words correct, but 17% of the 5-year-olds and 70% of the 6-year-olds reached criterion. An examination of the errors made on the phoneme and syllable tapping tasks also showed that errors decreased at successive grade levels for both tasks, but that children at each grade level made many more errors on phoneme tapping than on syllable tapping.

In a follow-up study at the beginning of the next school year, Liberman, Shankweiler, Liberman, Fowler, and Fischer (1977) administered the word recognition subtest of the Wide Range Achievement Test as a measure of reading achievement to the group of 6-year-olds from the Liberman et al. (1974) study. Half of the children who were in the lowest third of the class in reading achievement had failed the phoneme segmentation task the previous school year. However, none of the children who failed the task were in the top third of their class in reading achievement. This suggested that phonological awareness, as measured by phoneme segmentation, was related to reading achievement.

Some have argued, though, that the phoneme tapping task may be too difficult (e.g, Adams, 1990). The reason was that words do not consist of discrete sounds and children

are usually unaware that words can be broken up into individual phonemes before they begin reading instruction. Accordingly, other researchers have developed simpler measures of phoneme segmentation.

Fox and Routh (1975) had 3- to 7-year-olds segment two-phoneme and three-phoneme words by asking them to "tell me a little bit of." The two-phoneme words required only that the child utter one of the two sounds in response to the request to say a little bit of the word. For the three-phoneme words, after initially segmenting one of the phonemes the child was required to say a little bit of the remaining two sounds so that the word was eventually segmented into its individual phonemes. Prior to the experimental procedure, children were administered the Peabody Picture Vocabulary Test and the Reading Recognition subtest of the Peabody Individual Achievement Test. The Reading Comprehension subtest of the Peabody Individual Achievement Test was also given to children who scored 18 or higher on Reading Recognition. While 3-year-olds were able to segment only about 25% of the words, performance across the 3- to 6-year-olds showed a marked increase, which leveled off by 6 to 7 years of age. Also, correlations showed segmentation ability to be positively related to both subtests of the Peabody Individual Achievement Test. This indicated that the ability to segment words into phonemes,

which seemed to increase developmentally, may be related to reading achievement.

Lundberg, Olofsson, and Wall (1980) simplified segmentation by using "concrete" tasks. Concrete tasks used wooden pegs representing either a syllable or phoneme (depending on the task) in order to lessen the task demands and decrease memory load. Swedish kindergarten children (aged 7) were given several phonological awareness tasks: rhyme production, syllable segmentation, phoneme segmentation and reversal, "concrete" syllable segmentation, and "concrete" phoneme segmentation and reversal. In first and second grade children were given several tests of silent word reading, spelling, language comprehension, and language production. A path analysis revealed that concrete phoneme segmentation and reversal and, to a lesser extent, rhyming were the only reliable determinants of reading and writing skills even when holding IQ constant. Thus, the basic phonological awareness skill of rhyming and the more complex skill of manipulating phonemes (with the help of concrete representations) were related to beginning reading achievement.

All studies in this section have shown a relationship between phonemic awareness and beginning reading achievement. This relationship appears to be a reciprocal one. That is, the causal link between phonemic awareness and learning to read runs in both directions (reciprocal

causality) (Perfetti, Beck, Bell, & Hughes, 1987). This relationship is best illustrated by the reciprocal model where initial experience with print influences phonemic awareness, and the development of phonemic awareness further influences reading ability. Given the possibility of reciprocal causality, it has been argued that some grapheme-phoneme knowledge acquired from beginning reading instruction may influence performance on tasks that tap explicit phoneme knowledge (Adams, 1990; Catts, 1989).

It is possible that print experience, in the form of either being read to or reading instruction, was influencing performance on phonemic awareness tasks in the studies reviewed in this section. Since the phoneme tapping task in Liberman et al.'s (1974) study was administered at the end of the school year, it is possible that some experience in learning to read may have been contributing to the performance of some of the 6-year-olds. In fact, Liberman et al. (1974) have acknowledged that performance of the first grade children may be due to instruction in reading and writing. Likewise, the increase in phoneme segmentation ability by 6 years of age in the Fox and Routh (1975) study may have been due to some experience in learning to read at home or in beginning reading instruction at school. Moreover, it is likely that the Swedish kindergartners in the Lundberg et al. (1980) study may have been learning to read at home, even though the authors noted that they should

have no more formal instruction than the average kindergarten student in the United States.

Because these studies assessed phoneme knowledge, which may have been acquired from formal or informal experience in learning to read, it can only be concluded that explicit phonemic awareness is related to the process of learning to read. Therefore, other studies that attempt to control for reciprocal causality between phonological awareness and reading may provide clearer evidence for phonological awareness as an enabling skill.

Studies Controlling for Reciprocal Causality

Researchers have utilized several different techniques in an attempt to avoid the problem of reciprocal causality. One procedure involved the use of longitudinal studies begun before formal reading instruction. Another involved using reading-level match designs. In reading-level match designs a group of older students is usually matched with a group of younger students on the basis of reading ability.

The third way researchers have attempted to circumvent the problem of reciprocal causality was through sound categorization tasks. Some examples of sound categorization tasks are: rhyme production, rhyme detection, forced-choice rhyme (i.e. Which rhymes with boy: toy or box?), and oddity, in which subjects pick the odd word (in terms of initial, medial or final sound) from each list of 3 or 4 words. Unlike phoneme manipulation tasks, these tasks do not

require explicit knowledge of sounds or specific manipulations, but only the ability to attend to similarities and differences between component sounds of words. With implicit tests of phonological awareness such as these, it is less easily inferred that practice in reading text or learning letter-sound correspondences influences phonological awareness.

Reading-level Match Design. Bradley and Bryant 's (1978) reading-level match study has shown that certain phonological awareness skills may not be the result of practice in reading. They administered rhyming and oddity tasks to a group of 6-year-olds (normal readers) and 10-year-olds (delayed readers) matched for reading level. The results showed that performance of the 10-year-old delayed readers on both tasks was markedly inferior to the normal 6-year old readers. This can neither be attributed to a greater experience with reading on the part of the 6-year-olds, nor to the fact that the 10-year-olds did not understand the task since they were older and more intellectually mature. Instead, the result suggested a lower level of phonological awareness on the part of the delayed readers. Of course, a lower level of phonological awareness may not have been the only problem of the delayed readers, but it seemed to be one of them.

Longitudinal Studies. A longitudinal study by Bradley and Bryant (1983) has also provided evidence supporting the

position that reading ability is due in part to phonological awareness. The authors assessed phonological awareness prior to any formal instruction or practice in reading by testing only 4- and 5-year-olds who showed no signs of reading (who were unable to read any word in the Schonell reading test). The children were administered a memory span task, a verbal intelligence test, and three oddity tasks (initial, medial, and final sounds). About four years later children were given two standardized tests of reading achievement, a standardized spelling test and math test, and the Wechsler Intelligence Scale for Children. A correlation of .53 and .57 between performance on the oddity tasks and performance on the two reading tests was found. It was also found that oddity task performance significantly accounted for 4-10% of the variance in predicting reading achievement even when holding constant the influences of intelligence at initial and final test administrations and differences in memory. As expected, oddity performance did not predict mathematical skills. These results indicated that the ability to categorize words on the basis of their constituent sounds may be at least one factor in early reading success.

A longitudinal study by Ellis and Large (1987) also assessed phonological awareness prior to formal reading instruction. The investigators tested 4- and 5-year-olds on syllable and phoneme segmentation, sound blending, rhyme

production, and an oddity task. When the children were 8 years old, they were placed into three groups on the basis of IQ and reading level (measured by several reading, spelling, and vocabulary tests). These groups were: IQ normal/reading normal, IQ normal/reading lag (specific reading disability), and IQ and reading somewhat below normal (general reading problems). Of the top five variables that discriminated between normal readers and the reading lag group, oddity and rhyme production were the best. Interestingly, the implicit tests of phonological awareness, rather than the more difficult phoneme manipulations, successfully predicted reading achievement in this case. This reinforces the claim that the studies mentioned in an earlier section, which used phoneme manipulation tasks, may have been tapping a more sophisticated knowledge resulting from beginning reading instruction.

Maclean, Bryant, and Bradley (1987) have provided striking evidence for the relationship between beginning reading ability and phonological awareness by showing that basic phonological awareness skills acquired very early play a strong part in the subsequent development of reading ability. In the first session 3-year-old children were asked to recite some of the most popular nursery rhymes (determined by a pilot study). Assessment of phonological awareness included the following tasks: rhyme production,

rhyme detection, alliteration detection, alliteration production, forced-choice rhyme, and a segmentation task similar to that developed by Fox and Routh (1975). Rhyme and alliteration detection tasks, the most salient measures of phonological awareness for 3-year-olds, were readministered at four subsequent test points over the next 15 months to track the development of phonological awareness. Multiple regressions revealed a strong relationship between initial knowledge of nursery rhymes (the initial measure of phonological awareness) and subsequent ability to detect rhyme, even when controlling for IQ, mother's educational level, and initial rhyme detection performance. Furthermore, when children were classified by reading ability (those showing no signs of reading and those who could recognize at least one word) at the last test session, significant differences were found on rhyme and alliteration detection at 3-years-old. In contrast, no differences were found when the children were divided by letter recognition ability. Hence, an early awareness of rhymes and beginning sounds seemed to affect the subsequent development of reading skills.

The studies mentioned in this section provide support for the notion that phonological awareness enables reading acquisition. Findings from the reading-level match study by Bradley and Bryant (1978) suggest that implicit forms of phonological awareness are not by-products of experience

with print. Rather, phonological awareness appears to be at least one necessary factor in developing later reading ability, as indicated by several longitudinal studies. Thus, the results of these studies appear to be consistent with Bryant et al.'s (1990) models that propose some type of relationship (either direct or indirect) between implicit forms of phonological awareness and reading.

The findings, though, do not necessarily contradict the claim of the reciprocal model that phonemic awareness and reading are reciprocally related. The studies used tasks that tap implicit knowledge of the internal structure of words rather than explicit knowledge of phonemes. Thus, even though implicit forms of phonological awareness may enable reading acquisition, it is still likely that learning to read and phonemic awareness mutually influence each other.

Training Studies

The evidence thus far points to a reciprocal relationship between phonemic awareness and beginning reading ability and an enabling relationship between implicit forms of phonological awareness and beginning reading. One way to determine whether phonological awareness skills are enabling skills would be to examine the effects of training phonological awareness skills on subsequent reading ability. Training on phonological awareness leading to gains in reading ability would suggest

an enabling relation between phonological awareness and reading performance. Several training studies have shown that teaching some form of phonological awareness in a nonreading context affects word learning skills and reading performance of very young children and improves subsequent reading performance of children with poor phonological awareness skills.

Treiman and Baron (1983) trained preschool children to segment and blend the initial and remaining sounds of a set of spoken syllables (e.g., h/em, l/ig), and practice another set by just repeating them. Next they taught the children to associate the individual sounds from both sets of syllables with letters. The children then learned to read four items corresponding to the spoken syllables in a paired-associate learning task. These items were either identical to their spoken counterparts in the segmenting/blending or repetition condition (related), or were made from the segments used in these conditions but not practiced (unrelated). The results showed that children made fewer errors on syllables they segmented and blended than on those they repeated, regardless of whether the syllables were related or unrelated to the training conditions. Here, acquiring segmenting and blending skills through training enabled children to learn to read words.

Fox and Routh (1976) conducted a phonic blend training study with 4-year-olds. The children were divided into

high-ability and low-ability segmenters according to performance on the "say just a little bit" phoneme segmentation task. Half of each group of high- and low-ability segmenters either received no training or training in blending two sounds together. Both groups then learned to associate each sound with a letter-like form (sound-letter training), and then learned two lists of "words" consisting of the practiced letter-like forms. For the proficient segmenters, those with blending training learned the lists faster than those with no training, but for nonproficient segmenters, training did not seem to affect performance. It seems that some minimal level of phoneme segmentation ability allowed children to generalize blending and letter-sound training to learning words. However, phonological awareness training may have also been beneficial for the nonproficient segmenters if they had been given more than just the two 30-minute training sessions. Children with a lower level of phonological awareness may require more extensive training in order to see benefits of acquiring segmenting and blending skills on word learning.

In addition to enhancing word recognition skills, training phonological awareness improves later reading performance, as Bradley and Bryant's (1983) two-year study demonstrated. Sixty-five children aged 5- to 7-years old from Bradley and Bryant's 4-year longitudinal study (mentioned in an earlier section) were selected on the basis

of their poor oddity task performance. They were placed into one of four groups matched on verbal intelligence, age, and original scores on sound categorization. Training began in the second year of Bradley and Bryant's longitudinal project. Each group received one of the following conditions: sound categorization training, concrete sound categorization training using plastic letters to show grapheme-phoneme correspondences, training in categorizing words conceptually (conceptual categorization control), and no training.

At the end of two years, the two sound training groups outperformed the other groups on standardized tests of reading and spelling, but not on a test of mathematics. The concrete sound categorization group reliably exceeded the conceptual categorization control by 9 months in reading and 17 months in spelling. Yet, a 4-month advantage in reading and spelling of the sound categorization group over the conceptual group was not significant. Based on this, some have argued that sound categorization training does not improve reading achievement unless accompanied by letter-sound correspondence training (Wagner & Torgesen, 1987). Yet, the effect of sound categorization training should not be ignored because, as Stanovich (1986) has claimed, small differences appearing early may create larger differences later in development. Nevertheless, both sound training groups showed improved performance in reading as compared to

the controls, and did not differ significantly from each other on tests of reading achievement.

Lundberg, Frost, and Petersen's (1988) longitudinal training study with Danish preschool children supports the findings of Bradley and Bryant (1985) that phonological awareness training improves subsequent reading achievement. Intact preschool classes either received special training in phonological awareness (training group) or proceeded in the regular program with no special training (control group). Both groups were given several pretests at the beginning of the year prior to training. These tests included: a screening test for prereading ability, letter knowledge, language comprehension, vocabulary, and metaphonological tests. The metaphonological tests consisted of a variety of tasks: rhyme recognition, segmenting sentences into words, segmenting syllables, blending syllables, initial phoneme deletion, phoneme segmentation, and phoneme blending. The training program lasted for 8 months during which phonological awareness skills were introduced systematically from rhymes to syllables to phonemes by means of various games and exercises. In first and second grade, both groups were administered tests of mathematics, spelling, and reading, and Raven's Progressive Matrices to assess intellectual ability.

The results showed that letter knowledge performance and language comprehension performance changed very little

from pre- to posttest and were not significantly different between the training and control groups. On the metaphonological tasks, however, the control group significantly outperformed the training group at pretest, but the relationship at posttest was reversed. Furthermore, significant differences between the training group and control group were found on reading and spelling in first and second grade. Thus, not only did training in phonological awareness improve phonological awareness performance, but it also influenced subsequent reading performance.

Interestingly, phonological awareness training produced the most dramatic effect on subsequent phoneme performance, a less dramatic effect on word and syllable performance, and the most modest effect on rhyme performance. One reason for the differential effect may be that the more basic levels of awareness (i.e. awareness of rhymes and syllables) were developed first and provided a basis for learning phonemes. Thus, although training basic forms of awareness produced modest (but significant) effects, they may have been contributing to the dramatic effect of the phoneme tasks.

The training studies together indicate that various forms of phonological awareness training have an effect on subsequent word reading skill. Providing instruction in basic phonological awareness skills has been successful in improving subsequent reading performance. The segmenting

and blending training in the study by Treiman and Baron (1983), which utilized onsets (initial sounds) and rimes (rhymes), influenced preschool children's word learning performance. Also, the sound categorization training in the Bradley and Bryant (1985) study was effective in producing improvement in reading performance as compared to children who received no training. Instruction in phoneme awareness, though, may be even more successful in improving subsequent reading ability than training more basic forms of phonological awareness. The sound categorization training with letter-sound correspondences in the study by Bradley and Bryant (1985) proved to be slightly more effective than training sound categorizations alone in improving subsequent reading ability. Nevertheless, it appears that training some form of phonological awareness enables the development of subsequent reading skill.

A Relationship among Phonological Awareness Skills?

What becomes clear from the literature is that there are various phonological awareness skills that are related to beginning reading achievement. Some phonological awareness skills, such as explicit phonemic awareness, appear to develop as a by-product of learning to read or at least simultaneously with learning to read. More implicit phonological awareness skills, such as awareness of syllables and onsets and rimes (rhymes), appear to precede

reading acquisition. Most researchers would agree with this distinction.

The argument lies in the extent to which each form influences reading acquisition. Morais and colleagues (e.g., Morais, Bertelson, Cary, & Alegria, 1986; Morais, Alegria, & Content, 1987) stress the importance of phonemic awareness in learning to read and claim that rhyme and other implicit forms of awareness have no connection with phonemic awareness or reading. In contrast, many other researchers (e.g., Bryant, Maclean, Bradley, & Crossland, 1990; Treiman & Zukowski, 1991) not only claim that implicit forms of phonological awareness are important to later reading ability, but also suggest some type of connection between basic forms of phonological awareness and phonemic awareness.

Treiman and Zukowski (1991) have proposed that the development of phonological awareness skills may be organized hierarchically from awareness of the largest linguistic unit (i.e. syllables) to awareness of the smallest linguistic unit (i.e. phonemes). Preschool, kindergarten, and first grade children were asked to determine whether words began and ended with the same unit of sound in one of three conditions (syllables, onset-rime, or phonemes). In the syllable and phoneme conditions this meant comparing beginning or ending syllables and phonemes. In the onset-rime condition, same beginning sounds were

consonant cluster onsets and same ending sounds were rimes. It was found that for each age group the syllable task was easiest and the phoneme task was most difficult. In the onset-rime task, which was moderately difficult, performance was better for words that shared rimes than for words sharing onsets. In the phoneme task, shared initial phonemes (which were always part of a consonant cluster onset) were easier than shared final phonemes. Preliminary results from another experiment, in which kindergarten children made phoneme comparisons for words that either had a single consonant onset or a consonant cluster onset, showed that phoneme performance was better on onsets than on parts of onsets. Taken together, the results suggest that phonological awareness development may be organized according to linguistic levels that vary in their degree of difficulty.

A longitudinal study by Bryant et al. (1990), which was aimed at demonstrating relationship between several forms of phonological awareness and beginning reading ability, has indicated a connection between "early phonological awareness" skills (e.g., sensitivity to rhyme and alliteration) and phoneme awareness. Rhyme and alliteration detection tasks were administered to children when they were 4 and 5 years old, and three phoneme tasks (first sound deletion, end sound deletion, and phoneme counting) were administered when they were 5 years old. At 6 years old

children were given several tests of reading and spelling. Multiple regression analyses performed on reading scores using each of the three phoneme tasks as predictors revealed phoneme performance to predict reading performance over and above the effects of age, IQ, vocabulary, and social background. Regression analyses performed on phoneme scores using rhyme or alliteration scores as predictors revealed that rhyme (or alliteration) was a strong predictor of phoneme detection even after effects of the extraneous variables were controlled. Thus, rhyme (or onset) awareness seemed to be causally related to phoneme awareness, which then directly affected later reading ability.

At the same time, Bryant et al. (1990) also found evidence that rhyme (or onset) awareness may directly affect reading. When multiple regression analyses were performed on reading performance using both a test of phoneme awareness and either a rhyme or alliteration detection task, rhyme (or alliteration) detection was found to significantly predict reading performance even after accounting for the effects of extraneous variables and the effects of phoneme detection. Thus, there also seemed to be a direct link between implicit forms of phonological awareness (rhyme and alliteration) and reading ability somewhat independent of the relationship between rhyme (or alliteration) awareness and phoneme awareness.

The studies by Bryant et al. (1990) and Treiman and Zukowski (1991) both suggest some type of relationship among basic forms of phonological awareness and phonemic awareness. However, neither study specifically addresses a developmental pattern among phonological awareness skills. Bryant et al. (1990) show that either rhyme awareness or sensitivity to alliteration is causally related to subsequent phonemic awareness, but they do not include tests of rhyme and alliteration in the same analyses. Therefore, the relationship between rhyme and alliteration awareness remains uncertain. In contrast, Treiman and Zukowski (1991) do suggest a specific organization among phonological awareness skills. In particular, syllable awareness, rime awareness, onset awareness, and phoneme awareness vary in their degree of difficulty for young children. However, it is not known if these forms of awareness develop in this specific order. Treiman and Zukowski do not make direct comparisons of children in different age groups or track children's development of phonological awareness skills over time. It must be remembered, though, that neither study set out specifically to examine the developmental pattern of phonological awareness skills.

In conclusion, a large body of research has implicated several phonological awareness skills in the relationship between phonological awareness and beginning reading ability. One of these skills, namely phonemic awareness, is

most closely related to reading in that it develops alongside of learning to read. Other more basic forms of phonological awareness appear to enable reading acquisition. What remains unclear, however, is the relationship among the various forms of phonological awareness. There is some indication that phonological awareness may develop from simpler forms of awareness to more complex forms of awareness. Further examination of phonological awareness and its development would help clarify these issues.

Present Research

The purpose of the present research was to examine whether there is a developmental progression of phonological awareness skills. While previous research has shown that several different forms of phonological awareness are related to beginning reading achievement, it has not specifically addressed whether the various forms are acquired in a systematic fashion.

The developmental progression hypothesis proposed in this thesis suggests that a child's awareness of sounds begins with the simplest of phonological awareness skills and progresses toward more complex forms. This developmental hypothesis proposes that rhyme awareness is the basic building block of phonological awareness. Rhyme is found in many experiences of young children (e.g., nursery rhymes, games, and songs) and is easy for children to do. Recognition of onsets (i.e. phoneme or phonemes

corresponding to a single consonant or consonant cluster) seems to be an ability that is built upon rhyme sensitivity. Implicit in the recognition of rhyme is the realization that rhyming words (e.g., *fat* and *cat*) share a rime (-at) but not onsets. Once this is realized, the ability to recognize onsets as units of sounds discriminable from the rest of a word should follow. Children at this stage should be able to recognize initial phonemes that correspond to a single consonant onset. As children gain experience with printed words they develop the most sophisticated form of awareness called phonemic awareness, which requires knowledge that words consist of individual phonemes. Having acquired phonemic awareness, children should be able to recognize initial phonemes that are constituents of a consonant cluster onset, and should be able to recognize final phonemes, which involves breaking up the rime into its constituent phonemes.

Several studies have suggested such an order of phonological awareness skills. The Lundberg et al. (1988) training study, interestingly, began phonological awareness training with rhymes and ended with phonemes. Furthermore, a study by Stanovich, Cunningham, and Cramer (1984) indicated that rhyming and rhyme choice tasks were easiest for kindergarten children, tasks tapping knowledge of initial phonemes were moderately difficult, and tasks

assessing knowledge of final phonemes were the most difficult.

Another purpose of the present research was to examine the usefulness of response time measures as a way of assessing performance on phonological awareness tasks. Research on phonological awareness thus far has employed only accuracy measures, while research on other skills, such as word decoding and letter identification, has used response time as well as accuracy. Response time is the speed at which subjects can perform a given task and can serve as an index of the degree of automaticity of a skill. The importance of automaticity of word recognition skill for proficient reading is apparent in the following statement by Stanovich. "One does not obtain a clear picture of a child's decoding abilities unless speed and automaticity criteria are also employed. It is quite possible for accurate decoding to be so slow and capacity-demanding that it strains available cognitive resources and causes comprehension breakdowns" (1986, p. 373). Accordingly, response time measures of word recognition skill have been found to discriminate good and poor readers (e.g., Perfetti & Hogaboam, 1975).

Developmentally speaking, it is possible that lower-level prereading skills may need to become automatic in order for children to acquire and master beginning reading skills. As an instance, response time performance of

beginning first grade students on a letter naming task (reflecting automatic access of letter identities) has been found to predict subsequent reading achievement (e.g., Speer & Lamb, 1968). Similarly, it is likely that the extent of automaticity of phonological awareness skills may affect subsequent reading ability. Response time on phonological awareness tasks should therefore be explored and evaluated as an additional means of measuring phonological awareness skill.

In order to examine the issue of a developmental progression of phonological awareness skills, the study evaluated performance of kindergarten and first grade students in mainstream classrooms and Transitional Bilingual Education (TBE) program classrooms on several phonological awareness tasks. The inclusion of TBE students in the study provided an opportunity to examine phonological awareness skills in another language. Students in the TBE program were native Spanish-speakers (meaning they were raised in a Spanish-speaking household) and had limited proficiency in English. They received all or most of their subject-matter instruction in their native language and also received some instruction in English as a second language. Students in mainstream classrooms, on the other hand, varied in their linguistic background. Some students were of Hispanic descent and were raised in homes where both English and Spanish were spoken, while others were native English-

speakers (non-Hispanic). Yet, regardless of their linguistic background, all students were proficient in English. Therefore, instruction in mainstream classes was conducted only in English.

Rhyme detection, initial phoneme detection, and final phoneme detection tasks were used to represent three levels of phonological awareness that are hypothesized to range from least to most difficult. These tasks were presented in English and Spanish to first grade students in both mainstream and TBE classes and presented to kindergarten students only in their native language. Performance on the tasks was measured in terms of accuracy and response time.

Students were administered the phonological awareness battery on two occasions. The first administration took place in December and January and the second occurred in May and June.

The hypothesis tested in this study states that there is a developmental progression of phonological awareness skills. That is, phonological awareness proceeds from rhyme awareness to awareness of initial phonemes (single consonant onsets), to full-fledged phonemic awareness (represented by awareness of final phonemes). The developmental progression hypothesis would be supported by a pattern that showed performance on the rhyme detection task to be best, followed by initial phoneme detection, and then final phoneme detection. Given that beginning kindergarten and first

grade students have not yet begun (or have just begun) to acquire letter-sound correspondences and to learn to read, they should have most experience with rhymes and least experience with final sounds. Support for the developmental progression hypothesis would also be evident if there were differential gain on the tasks over time. Specifically, the hypothesis would suggest that kindergarten and first grade children (who presumably have acquired some rhyming skills prior to attending school) would be likely to gain more on the initial and final phoneme tasks than on the rhyme task. Moreover, the hypothesis would suggest that kindergarten students would make gains on different tasks, or on more tasks, than the first grade students, assuming that kindergarten children have less developed phonological awareness skills.

CHAPTER 2

METHOD

Subjects

Subjects were first grade and kindergarten students enrolled in two western Massachusetts school systems whose parents gave consent for their participation in the study.

One school system was located in a large city populated mainly by working-class and minority families. This school system will be referred to as the lower socioeconomic status (SES) school system. Subjects in this school system were 42 kindergarten students and 27 first grade students. Twenty of the kindergarten students and 13 of the first grade students were native Spanish-speaking students enrolled in a Transitional Bilingual Education (TBE) program. Students at this level in the TBE program received all subject-matter instruction in their native language and began English as a Second Language (ESL) instruction. The remaining students (22 kindergarten and 14 first grade students) were enrolled in mainstream classrooms where all instruction was given in English.

The other school system was located in a small urban town populated by working- and middle-class families. This school system will be referred to as the higher SES school system. Subjects in this school system were 32 kindergarten students and 16 first grade students enrolled in mainstream classrooms where instruction was given in English.

At the second test administration, the number of subjects differed slightly due to attrition. In the lower SES school system, the number of TBE kindergarten students decreased from 20 to 14, and the mainstream kindergarten and first grade samples each decreased by 1. In the higher SES school system, the kindergarten sample also lost one subject.

There were also students who failed to complete all tasks at either the first or second test administration. In the TBE group, 3 kindergarten students at time 1 and 1 at time 2 did not complete the tasks. Two TBE first grade students had incomplete data at time 2. The mainstream group from the same school system as the TBE group had 1 kindergarten student at time 1 and 2 at time 2 with incomplete data. All subjects in the mainstream group from the higher SES school system had complete data.

The analyses that will be described were based on only those children who completed all tasks at both test administrations. In the lower SES school system, the TBE group consisted of 10 kindergarten students and 11 first grade students who completed both phases of the study. Twenty kindergarten and 13 first grade students comprised the mainstream group in this school system, while 29 kindergarten and 16 first grade children comprised the mainstream group in the higher SES school system. This made

a total of 49 kindergarten and 29 first grade students in the mainstream group.

Materials

Tasks

Three tasks were used to represent different levels of phonological awareness: rhyme detection, initial phoneme detection and final phoneme detection. These sound detection tasks, sometimes called word-to-word matching in the literature, required the subject to detect a similarity between two words in terms of a particular target sound, in this case, rhyme, initial phoneme, and final phoneme. Tasks were developed in both English and Spanish. Each task contained 13 pairs of words, consisting of 3 practice and 10 test trials. On half of the test trials in each task, the words were similar in terms of the target sound. On the other half the pairs were different, having no sounds in common. Tasks were presented in the following order: rhyme detection, initial sound detection, and final sound detection. A pilot study using all possible combinations of presentation order revealed that the order in which the three tasks were presented was not a factor influencing performance.

Stimuli

The stimuli for the tasks were 3-phoneme Consonant-Vowel-Consonant (CVC) words. (See Appendix A for list of stimuli). These words were selected because they represent

the easiest patterns for children to detect similarities. Detecting rhyme requires listening for the -VC similarities. Detecting initial or final phonemes only requires listening for a consonant at the beginning or end of words. The rationale selecting stimulus items can be found in Appendix B.

Apparatus

A Bell & Howell tape recorder (model 3181A) was used to present the stimuli. A Toshiba T3100/20 laptop computer and a Leading Edge 386SX laptop computer were used to record accuracy and response time (RT) data. All programming was done using Micro Experimental Laboratory software (Schneider, 1988).

Response times were recorded by the computer in the following manner. The tape recorder was controlled by a remote switch operated by the experimenter. Depressing the switch kept the tape running and releasing the switch stopped the tape. At the same time the experimenter released the switch to stop the tape, she also pressed a button on a response box that was connected to the computer. Pressing this button sent a signal to the computer to start the timer. The subject's button press on the computer (YES or NO) stopped the timing loop thereby recording response time.

Accuracy was also recorded by the computer. The pairs of words in each task were assigned a random order once.

This order was recorded on audio tape and used for all subjects. For every task, the pairs of words were coded as a YES pair (they have the same sound) or NO pair (they have different sounds). The YES and NO codes were programmed into the computer in the order in which the pairs were presented on audio tape. This allowed the subject's key press to be automatically recorded as correct or incorrect.

Procedure

The phonological awareness battery was administered on two occasions. The first testing took place during December and January and the retesting took place during May and June. The administration of the phonological awareness measures was identical for both test occasions.

Students were tested individually. Both mainstream and TBE first grade students completed the tasks in English and Spanish. Each task was presented with the Spanish version followed by the English version for TBE students and English version followed by the Spanish version for the mainstream students. Kindergarten students were only given the tasks in their native language. That is, TBE students received only the Spanish tasks and mainstream students completed only the English tasks. The reason was that kindergarten students would experience fatigue and loss of interest if given 6 tasks in one sitting.

The rest of the procedure was the same for both kindergarten and first grade students. Instructions were

given in Spanish for the TBE students and in English for the mainstream students. Prior to each task, subjects were given examples of words with the target sound to insure they understood what rhymes, initial sounds, and final sounds were. Then they were told that they would hear pairs of words on a tape recorder. For the rhyme task, the subjects were told to press YES if the two words rhymed and NO if they did not. In the initial and final phoneme tasks, children were told to press YES if the words started (ended) with the same sound and NO if they started (ended) with different sounds. The experimenter also provided examples of this and prompted children to press the appropriate button in order to insure students understood the task demands.

Student information was collected during the first testing occasion. Students were asked their age and the language spoken at home. Teachers also provided information regarding each student's phonological awareness skills and potential reading ability in their native language. Phonological awareness ability was judged on the basis of skills like rhyming, detecting rhyme, knowledge of nursery rhymes, and ability to blend sounds together or manipulate sounds. Potential reading ability was judged on the basis of the student's potential for becoming a good or poor reader when reading instruction begins. Teachers were asked to rate students using a 1- to 9-point scale. The rating

process involved having teachers assign a rating of 9 to the student in their class who was the very best in the particular skill and assign a rating of 1 to the student who was the poorest in the skill. Then the teachers were to assign the rest of the class ratings from 2 to 8 with the majority of the class receiving "average" ratings of 4, 5, and 6. This procedure was used in order to get a range of ratings that differentiated between students at different skill levels and that approximate a normal distribution.

Data Cleaning

Due to the small number of items in each task, eliminating outlier responses from the response time data would not be appropriate. Thus, the data cleaning process involved replacing a subject's outlier responses in each task with the subject's own mean score for a particular task. Outliers were identified as response time scores that were two standard deviations above the subject's mean. Because the data were skewed to the left, it was not possible to identify unusually fast responses by this same criterion. Thus, an arbitrary cut-off point of 100 milliseconds (msec) was employed. A subject's response that was lower than 100 msec was replaced by the subject's own mean for the particular task.

CHAPTER 3

RESULTS

Analyses testing the developmental progression hypothesis were conducted separately for the TBE and mainstream groups because the hypothesis was concerned with phonological awareness development in one's native language. Tables 1 and 2 present descriptive statistics on time 1 and time 2 phonological awareness measures for the mainstream and TBE groups, respectively.

There were five expectations for the analyses of the developmental progression hypothesis. The first expectation was a difference in performance on the phonological awareness tasks as a function of grade level. First grade students should perform more accurately and more efficiently (as reflected by faster response times) on the tasks than kindergarten students due to their greater experience with word sounds. Second, improvement in performance from time 1 to time 2 would also be expected as a result of exposure to activities in kindergarten and first grade that provide experience with word sounds. Improvement in performance would be demonstrated by an increase in accuracy and a decrease in response time (RT), which would indicate greater efficiency in completing the tasks. Moreover, the developmental hypothesis would suggest differential performance as a function of type of task. Accuracy

Table 1

Performance of Mainstream Students on English Phonological Awareness Tasks at Time 1 and Time 2

	Time 1		Time 2	
	Mean	Std Dev	Mean	Std Dev
Kindergarten				
Rhyme ACC[a]	.81	.22	.85	.18
Rhyme RT[b]	1590.38	1337.36	1377.36	1005.69
Initial Phoneme ACC	.61	.19	.72	.18
Initial Phoneme RT	1932.28	1516.02	2319.15	1867.46
Final Phoneme ACC	.60	.20	.71	.21
Final Phoneme RT	2383.38	2093.10	2775.28	1948.44
First Grade				
Rhyme ACC	.91	.17	.95	.09
Rhyme RT	987.38	1220.93	915.15	824.26
Initial Phoneme ACC	.77	.19	.83	.14
Initial Phoneme RT	1111.35	718.71	1221.90	807.61
Final Phoneme ACC	.77	.21	.86	.16
Final Phoneme RT	1642.19	972.77	1964.06	1324.81

N=78
a ACC=accuracy
b RT=response time

Table 2

Performance of TBE Students on Spanish Phonological Awareness Tasks at Time 1 and Time 2

	Time 1		Time 2	
	Mean	Std Dev	Mean	Std Dev
Kindergarten				
Rhyme ACC	.52	.11	.52	.16
Rhyme RT	2212.30	1359.10	2180.69	2291.51
Initial Phoneme ACC	.50	.24	.62	.16
Initial Phoneme RT	2358.93	2192.51	2256.39	2426.00
Final Phoneme ACC	.55	.17	.53	.12
Final Phoneme RT	1844.99	1766.82	2670.62	4298.04
First Grade				
Rhyme ACC	.72	.24	.87	.15
Rhyme RT	1021.35	277.22	956.90	454.63
Initial Phoneme ACC	.59	.19	.72	.23
Initial Phoneme RT	1763.53	2076.33	2215.97	1303.60
Final Phoneme ACC	.57	.19	.75	.19
Final Phoneme RT	1519.76	1275.67	2171.57	1503.48

N=21
a ACC=accuracy
b RT=response time

performance should be highest on the rhyme task, followed by the initial phoneme task, and then final phoneme task. Response times should be highest on the final phoneme task, lower for the initial phoneme task, and lowest on the rhyme task. Additional support for the developmental progression hypothesis would be evident if there were differential gain on the tasks over time. Specifically, the hypothesis would suggest that kindergarten and first grade children (who presumably have acquired some rhyming skills prior to attending school) would be likely to gain more on the initial and final sound tasks than on the rhyme task. The final expectation of the developmental hypothesis was that kindergarten students would show a different pattern of gains on the tasks as compared to first grade students, assuming that kindergarten children have less developed phonological awareness skills.

A multivariate analysis of variance procedure was used to examine all expectations of the developmental progression hypothesis. The expectation for differential gain on the tasks and the possibility that different grades may show a different pattern of gains were also examined using correlated t tests. The reason for using t tests was to attempt to pinpoint exactly where gains were occurring. The use of t tests in addition to the overall analysis of variance accords with the position of Myers and Well (1991)

that planned contrasts may be conducted whether or not overall F tests are significant.

Mainstream Group

Overall Analyses

Accuracy and response time (RT) scores from time 1 and time 2 were examined separately using a multivariate analysis of variance procedure. Grade (kindergarten v. first grade) and school system were treated as between-subjects factors, and type of task (rhyme, initial phoneme, final phoneme) and time (time 1 and time 2) as within-subject factors. School system was included as a factor in these analyses because there was reason to believe that performance might vary as a function of the differences in the school communities. In addition, some effects involving these factors reached significance at the .10 level. The reasons for retaining school system as a factor in the analyses were consistent with the recommendation of Myers and Well (1991) that factors be pooled when they are believed to reflect only chance variability and when they do not reach significance at the .25 level.

Figure 1 summarizes the accuracy performance of the mainstream students on English phonological awareness tasks at time 1 and time 2. The analysis of the accuracy data revealed significant main effects of grade, time, and task [grade, F (1, 74) = 16.63, $p < .001$; time, F (1, 74) = 37.49, $p < .001$; task, F (2, 148) = 42.10, $p < .001$]. As

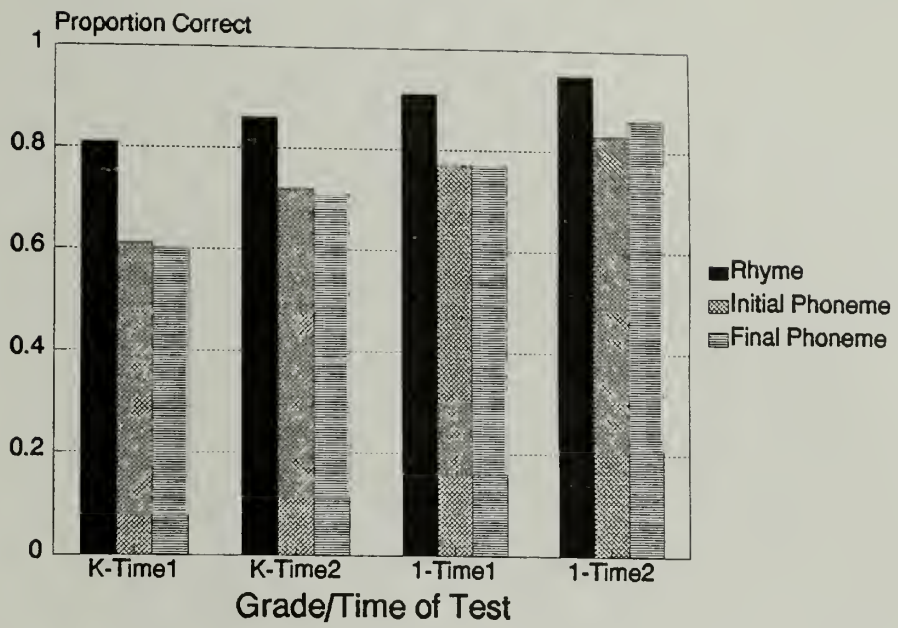


Figure 1. Time 1 and Time 2 Accuracy Performance of Mainstream First Grade and Kindergarten Students on English Phonological Awareness Tasks

can be seen from the figure, first grade students performed more accurately than kindergarten students (the grade effect), and both grades improved their performance over time (the time effect). Also, students were generally more accurate on the rhyme task than on the initial phoneme and final phoneme tasks (the task effect).

The only significant interaction was that of school system by task [F (2, 148) = 4.06, $p < .05$]. This interaction reflects a different pattern of performance on the phonological awareness tasks for students in the two school systems. Students in the lower socioeconomic status (SES) school system performed as would be expected according to the developmental progression hypothesis. That is, performance on the rhyme task was highest and performance on the final phoneme task was lowest. Students in the higher SES school system also performed best on the rhyme task, but performed slightly better on the final phoneme task than on the initial phoneme task.

Figure 2 displays response time performance of the mainstream group on phonological awareness tasks at time 1 and time 2. It is clear from the figure that rhyme performance was fastest and final phoneme performance was slowest, and that first grade students were faster than kindergarten students, as expected. Significant main effects of grade [F (1, 74) = 10.69, $p < .01$] and task [F (2, 148) = 28.06, $p < .001$] were found.

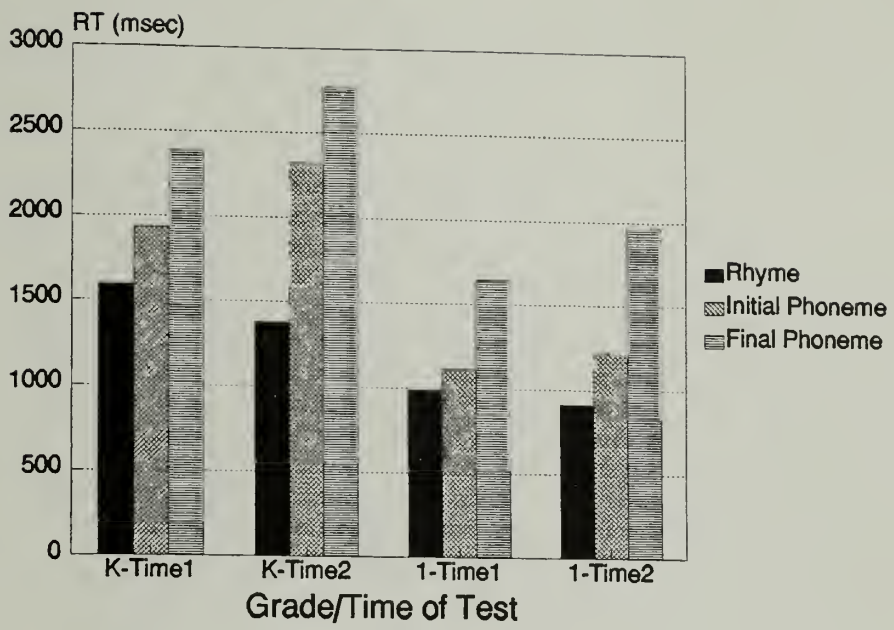


Figure 2. Time 1 and Time 2 Response Time Performance of Mainstream First Grade and Kindergarten Students on English Phonological Awareness Tasks

A significant time by task interaction [F (2, 148) = 4.00, $p < .05$] was also obtained. The nature of this interaction was that RT performance on the rhyme task decreased from time 1 to time 2 (as expected), but RTs on the initial and final phoneme tasks increased from time 1 to time 2. Students on the average performed 160 milliseconds (msec) faster on the rhyme task at time 2 than at time 1, but they performed 284 msec slower on the initial phoneme task and 365 msec slower on the final phoneme task.

The interaction of time and task represents a speed/accuracy tradeoff in gains made across test administrations on the initial and final phoneme tasks. At time 1, students were generally very accurate (an average score of about .85) on the rhyme task. Because of their general success on the rhyme task at time 1, students were able to improve their accuracy as well as their speed. On the other hand, performance on the initial and final phoneme tasks at time 1 was generally quite poor. Students had an average score for both tasks of only about .67 (compared to a chance level of .5). Therefore, at time 2 when students improved their accuracy they did so at the expense of becoming slower.

T Tests

The significant interaction of time and task found for the analysis of RT measures suggested that efficiency of performance on the rhyme task was improving over test

administration. The pattern of accuracy performance also suggested that rhyme detection was more developed at both time 1 and time 2 than initial phoneme and final phoneme detection.

The expectation for a differential gain in performance on the three phonological awareness tasks was examined further using a series of correlated t tests. Time 1 and time 2 scores were compared on each task (averaged over grade). This was done separately for accuracy and RT measures. In order to insure that the family-wise error did not exceed .05, an alpha level of .016 was used, which was determined by the number of analyses.

The analysis of accuracy measures revealed significant differences in performance over test administration on the initial phoneme and final phoneme tasks [initial phoneme, t (78) = -4.54, $p < .001$; final phoneme, t (77) = -4.61, $p < .001$]. The mean accuracy score on the initial phoneme task increased from .67 at time 1 to .76 at time 2. The average accuracy performance on the final phoneme task increased from .67 at time 1 to .77 at time 2. The difference in performance from time 1 to time 2 on the rhyme task was marginally significant [t (80) = -2.43, $p < .02$]. Overall performance on the rhyme task only increased from .84 at time 1 to .88 at time 2. This pattern of results indicates that initial phoneme performance and final phoneme performance were improving, but rhyme performance was not

improving as much due to the high level of performance achieved at the outset of the study. None of the analyses performed on RT measures were significant at the .016 level.

The expectation that there would be a different pattern of gains on the tasks for kindergarten and first grade students was evaluated using a series of correlated t tests. For each grade, time 1 and time 2 scores were compared on each task. This was done separately for accuracy and RT measures. In order to insure that the family-wise error did not exceed .05, an alpha level of .008, determined by the number of analyses, was used.

The analysis of accuracy measures involving kindergarten students revealed significant differences in performance over test administration on the initial phoneme and final phoneme tasks [initial phoneme, t (49) = -4.12, p < .008; final phoneme, t (48) = -3.40, p < .008]. Kindergarten students improved their performance on the initial phoneme task from .61 to .72 and on the final phoneme task from .60 to .71.

Like the kindergarten students, first grade students showed significant differences in accuracy performance over time on the final phoneme task [t (28) = -3.37, p < .008]. The performance of first grade students on the final phoneme task improved from .77 to .86. However, first grade students did not make significant gains on the initial phoneme task even though their performance increased

substantially from .77 to .83. The analyses of RT measures did not reach significance at the .008 level for either grade level.

TBE Group

Overall Analyses

Accuracy performance of the TBE students on Spanish phonological awareness tasks at time 1 and time 2 is depicted in Figure 3. As illustrated in the figure, first grade students performed better than kindergarten students at time 1 and time 2, and both grades improved their performance over time. A multivariate analysis of variance was performed on time 1 and time 2 accuracy scores with grade (first grade v. kindergarten) as a between subject factor and type of task (rhyme, initial phoneme, final phoneme) and time (time 1 and time 2) as within subject factors. It was not necessary to include school system as a factor in analyses concerning the TBE group since all TBE students were from the same school system. The analysis revealed significant main effects of time and grade [time, F (1, 19) = 9.48, $p < .01$; grade, F (1, 19) = 13.8, $p < .01$]. A significant grade by task interaction [F (2, 38) = 4.28, $p < .05$] was also found.

Figure 4 displays RT performance of the TBE group at time 1 and time 2. As can be seen in the figure, first grade students seemed to be faster on the tasks than kindergarten students at time 1 and time 2. Contrary to the

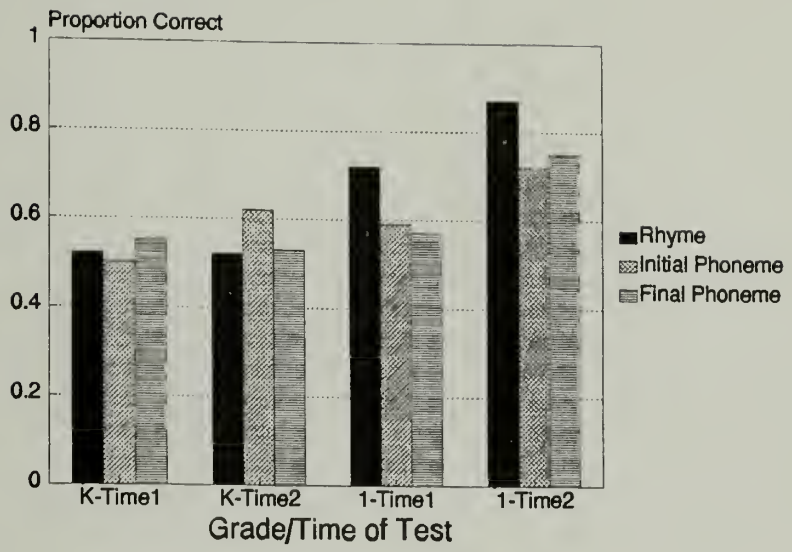


Figure 3. Time 1 and Time 2 Accuracy Performance of TBE First Grade and Kindergarten Students on Spanish Phonological Awareness Tasks

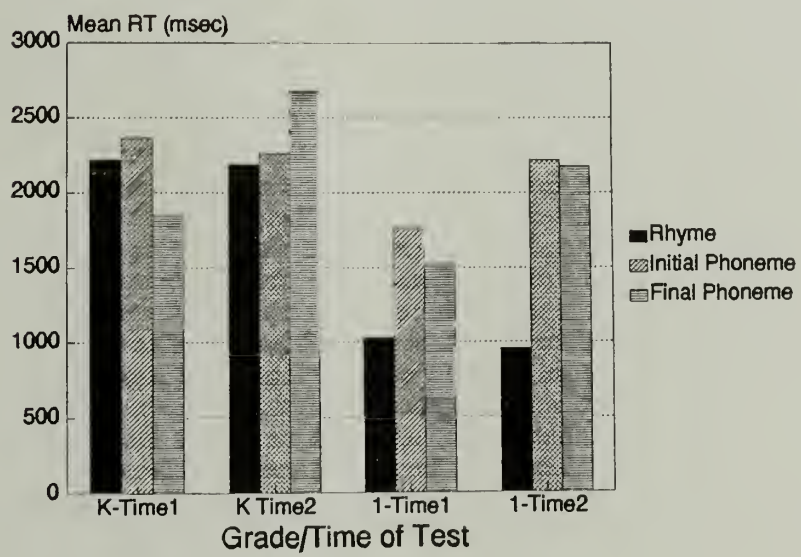


Figure 4. Time 1 and Time 2 Response Time Performance of TBE First Grade and Kindergarten Students on Spanish Phonological Awareness Tasks

expectations, performance for both grades also seemed to be slower in general at time 2. Time 1 and time 2 RT scores were subjected to a multivariate analysis of variance in the same manner as mentioned in the above paragraph for accuracy scores.

The analysis of RT measures revealed no significant differences. Although there were no significant differences for RT, the performance of TBE first grade students, as shown in Figures 3 and 4, indicated a speed/accuracy tradeoff in gains across test administrations on the initial and final phoneme tasks that was similar to the speed/accuracy tradeoff found for the mainstream group as a whole. TBE first grade students performed well above chance on the rhyme task at time 1 (an average score of about .72). Because they were able to perform the rhyme task somewhat successfully at time 1, students were able to improve their accuracy as well as their speed. Accuracy increased to about .87 at time 2, and RT decreased from 1027 msec to 957 msec. On the other hand, performance on the initial and final phoneme tasks at time 1 was generally quite poor. Students had an average score of .59 on the initial phoneme task and .57 on the final phoneme task (compared to a chance level of .5). Therefore, at time 2 when students improved their accuracy they did so at the expense of becoming slower.

T Tests

The expectation for differential gain on the phonological awareness tasks and the expectation that gains may be made on different tasks for each grade were examined using t tests, as they were for the mainstream group.

A series of correlated t tests were performed to determine whether there were gains in performance on each of the phonological awareness tasks. This set of t tests was performed by averaging over grade. Time 1 and time 2 accuracy measures were compared on each task, and the same was done for time 1 and time 2 RT measures. In order to insure that the family-wise error did not exceed .05, an alpha level of .016 was used determined by the number of analyses. Neither the analyses of the accuracy measures nor those of the RT measures were significant at the .016 level.

Correlated t tests were also performed to evaluate the expectation of a different pattern of gains on the tasks for kindergarten and first grade students. For each grade, time 1 and time 2 scores were compared on each task. This was done separately for accuracy and RT measures. In order to insure that the family-wise error did not exceed .05, an alpha level of .008, which was determined by the number of analyses, was used. Neither the analyses of accuracy measures nor of the RT measures were significant at the .008 level for kindergarten and first grade students.

Neither set of t tests revealed significant gains on the phonological awareness tests. However, Figure 3 indicated some sign of improvement over time, at least for the first grade students. The accuracy performance of the first grade students increased noticeably from time 1 to time 2 on all tasks. Thus, failure to obtain significance may have been due to the small number of subjects included in the t tests. Failure to obtain significance may also have been due to chance level performance of the TBE group. Performance of the kindergarten students on the three phonological awareness tasks was generally around chance level at time 1 and time 2, while performance of first grade students was generally around chance level at time 1 on the initial and final phoneme tasks.

Since it appeared that the TBE first grade students may have been making gains on the phonological awareness tasks, performance of the TBE group was examined with another analysis.

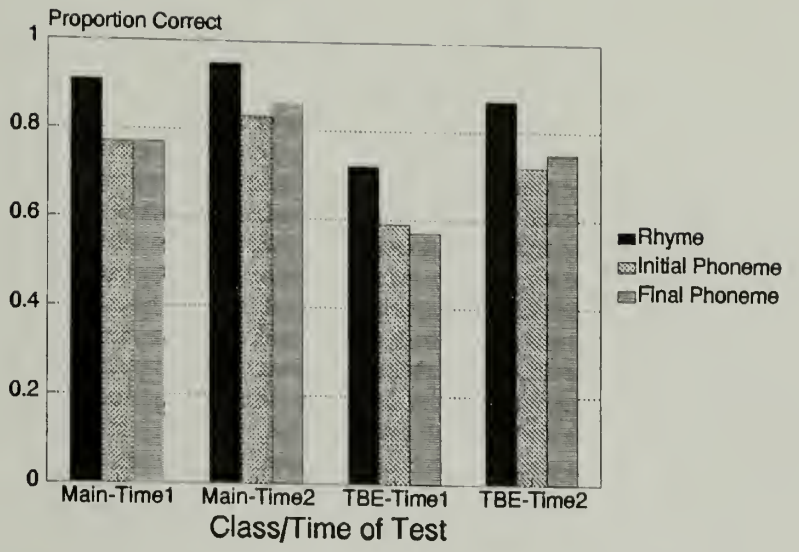
Mainstream and TBE Comparison of Native Language Accuracy Gains

The multivariate analyses of variance and the t tests both suggested that TBE children were not making significant gains on the phonological awareness tasks over test administration. However, Figure 3 showed substantial improvements of the TBE first grade students on phonological awareness tasks at time 2. In order to further evaluate

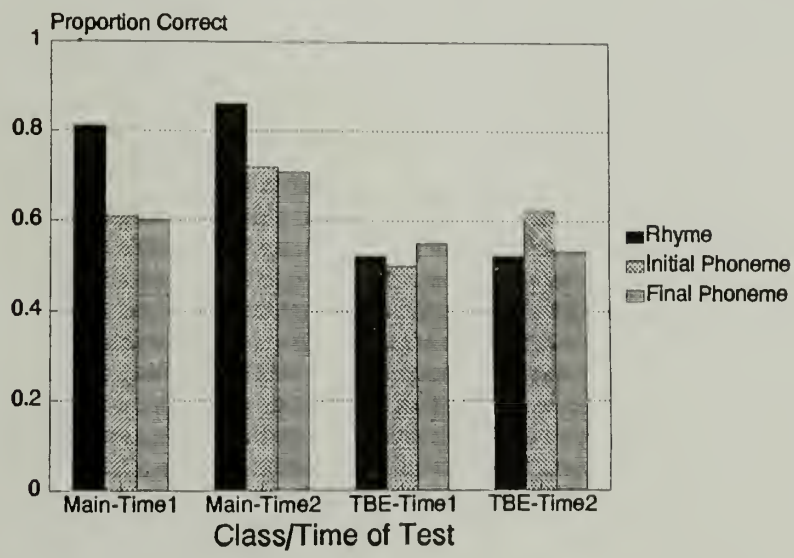
whether TBE children were making gains, their performance over test administration on native language phonological awareness tasks (i.e. Spanish) was examined relative to the performance of the mainstream group on their native language phonological awareness tasks (i.e. English).

Multivariate analyses of variance were conducted separately on native language accuracy scores and on native language RT scores. Class (TBE v. mainstream) and grade were treated as between subject factors, and time (time 1 and time 2) and task (rhyme, initial phoneme, final phoneme) were treated as within subject factors. Accuracy performance of mainstream and TBE first grade students on native language phonological awareness tasks over time is displayed in Figure 5a, and accuracy performance of mainstream and TBE kindergarten students on the tasks at time 1 and time 2 is shown in Figure 5b. Figure 6a displays the RT performance of mainstream and TBE first grade students on native language phonological awareness tasks over time, and Figure 6b shows RT performance of mainstream and TBE kindergarten students on the native language tasks.

The analysis of accuracy measures revealed significant effects of class, grade, time, and task [class, F (1, 95) = 25.09, $p < .001$; grade, F (1, 95) = 20.65, $p < .001$; time, F (1, 95) = 36.36, $p < .001$; task, F (2, 190) = 17.97, $p < .001$]. An interaction of class and task and a class by grade by task interaction were also significant

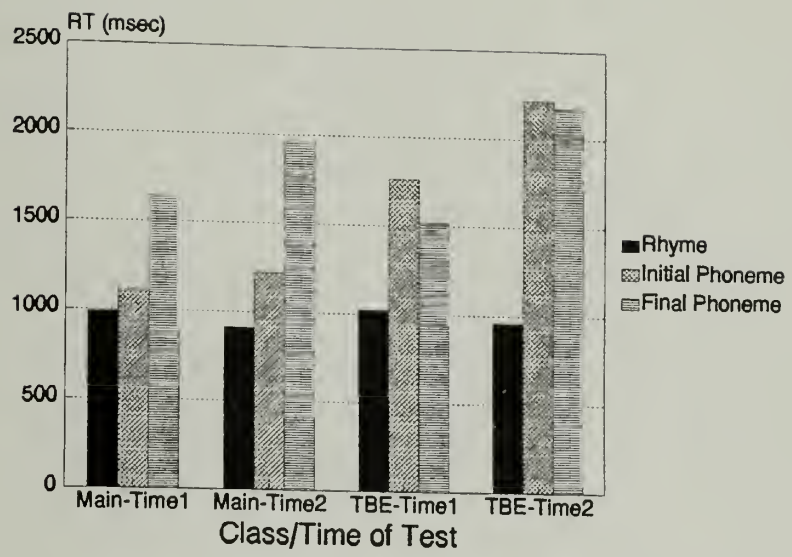


5a. Accuracy Performance of Mainstream and TBE First Grade Students

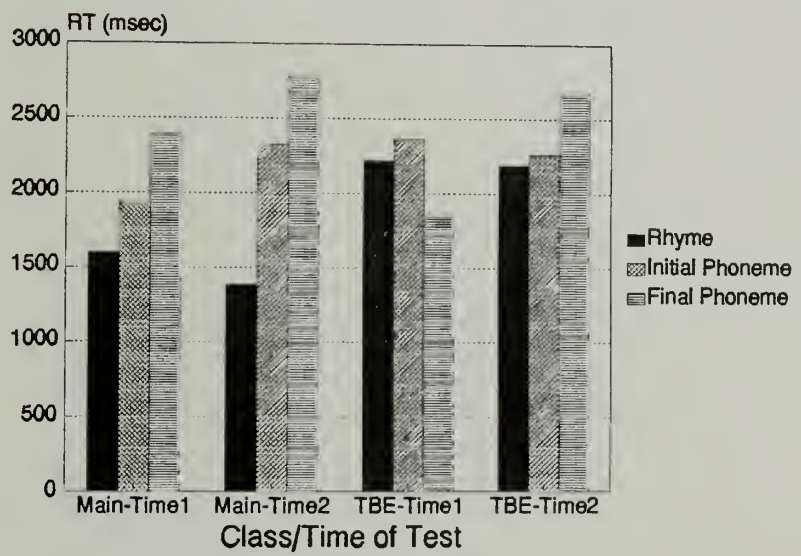


5b. Accuracy Performance of Mainstream and TBE Kindergarten Students

Figure 5. Time 1 and Time 2 Accuracy Performance of Mainstream and TBE Students on Native Language Phonological Awareness Tasks



6a. Response Time Performance of Mainstream and TBE First Grade Students



6b. Response Time Performance of Mainstream and TBE Kindergarten Students

Figure 6. Time 1 and Time 2 Response Time of Mainstream and TBE Students on Native Language Phonological Awareness Tasks

[class by task, F (2, 190) = 3.91, $p < .05$; class by grade by task, F (2, 190) = 5.40, $p < .01$].

The analysis also revealed a significant interaction of class, grade, and time [F (1, 95) = 6.27, $p < .02$]. The nature of this interaction was that a differential gain on native language phonological awareness tasks occurred as a function of type of class (mainstream v. TBE) and as a function of grade. As can be seen in Figure 5a, the mainstream first grade students made only slight gains on their native language phonological awareness tasks. However, the TBE first grade students improved substantially on their native language tasks, gaining about .15 on the rhyme task, .13 on the initial phoneme task, and .18 on the final phoneme task. Figure 5b shows that the mainstream kindergarten students, like mainstream first grade students, also made small gains (although they were greater than gains of first grade students), while the TBE kindergarten group seemed to make gains only on the initial phoneme task. In other words, more gain was made by students who had poorly developed phonological awareness skills (i.e. TBE first graders v. mainstream first graders, and mainstream kindergartners v. mainstream first graders), with the exception of TBE kindergarten students.

The analysis of RT scores revealed significant effects of grade and task [grade, F (1, 95) = 6.42, $p < .02$; task, F

(2, 190) = 12.47, $p < .001$] and a significant interaction of time and task [F (2, 190) = 4.45, $p < .02$].

CHAPTER 4

DISCUSSION

The purpose of this study was to examine the hypothesis that phonological awareness skills develop in a systematic fashion. Three phonological awareness tasks that represent different forms of phonological awareness were administered to kindergarten and first grade students on two test occasions in order to evaluate this hypothesis.

Developmental Differences in Phonological Awareness Skill

The results of this study support previous research findings of developmental differences in phonological awareness skill (e.g., Fox & Routh, 1975; Liberman, et al., 1974; Lomax & McGee, 1987). The multivariate analyses of variance reveal significant grade level differences in accuracy performance for both the mainstream and TBE groups. Significant differences in accuracy performance over a 5-month time span are also evident for both groups.

This study expands on previous studies by including response time (RT) as an additional means of assessing phonological awareness performance. The analysis of RT measures for the mainstream group reveal significant differences between first grade and kindergarten students in the efficiency of their performance. Once a child is able to detect similarities in word sounds with some degree of mastery, as the first grade children seemed to do, it

appears that the proficiency in detecting sounds begins to develop.

In contrast to the mainstream group, the TBE group shows no significant differences in RT performance on the phonological awareness tasks. The reason may be that the TBE students have not achieved a sufficient level of mastery of phonological awareness skills in order to begin to develop efficiency of performance. To illustrate, inspection of Figures 1 and 3 shows that TBE first grade students at time 1 (Figure 3) have not achieved the level of accuracy performance on their native language phonological awareness skills that mainstream kindergarten children have achieved at time 1 on their respective skills (Figure 1). The mean accuracy performance of TBE first grade students on the Spanish rhyme, initial phoneme, and final phoneme tasks is 72%, 59%, and 57%, respectively, whereas the performance of mainstream kindergarten students on the corresponding English tasks is 81%, 61%, and 60%. Although it is not appropriate to make direct comparisons of these two groups since they completed phonological awareness tasks in different languages, the comparison points out that increasing the efficiency of detecting the sounds of one's language depends on gaining some level of mastery through experience and practice with the language.

Evidence for a Developmental Progression

The hypothesis that phonological awareness skills may develop in a systematic fashion was examined with multivariate analyses of variance and with correlated t tests.

The multivariate analyses of variance performed on accuracy and RT measures for the mainstream group provide some support for a developmental progression of the three phonological awareness skills. The significant task effect (found for both accuracy and RT measures) and the overall pattern of performance in Figure 1 suggest that rhyme awareness is developing before initial and final phoneme detection skills. In fact, it appears from the accuracy data that initial phoneme and final phoneme detection skills are developing simultaneously. However, inspection of Figure 2 indicates a speed/accuracy tradeoff whereby students are performing much slower on the final phoneme task than on the initial phoneme task even though they are achieving about the same level of accuracy performance on both tasks.

Evidence for differential gain on the phonological awareness tasks further supports the notion that rhyme awareness is developing before awareness of other sounds. First, correlated t tests show significant gains in accuracy performance of the mainstream students on only the initial phoneme and final phoneme tasks. From inspection of Figure

1, it appears that students may have achieved a ceiling on the rhyme detection task at time 1 so that improvement over a 5-month time span was minimal. In comparison, the poorer performance on the initial and final phoneme tasks at time 1 allowed greater room for improvement within the short time period. Second, the significant time by task interaction found for the RT scores of the mainstream students also suggests that rhyme awareness has developed before other skills. Although children improved their accuracy on all three tasks over test administration, they were only able to increase their efficiency on the rhyme detection task.

The pattern of gains on the phonological awareness tasks for each grade also indicate that rhyme awareness may be developing prior to the other skills. Correlated t tests on accuracy measures for the mainstream kindergarten students do not show a significant gain on rhyme task performance, which is around 81% at time 1, but do indicate significant gains on the initial and final phoneme tasks over the 5-month time span. This suggests that the ability to detect initial and final phonemes was in the process of developing during this time period while the ability to detect rhyme, which seems to have been acquired to some degree, was not improving as much.

A similar pattern appears to be occurring with the mainstream first grade students. These students seem to have mastered rhyme detection at time 1 since they are

performing at 91% accuracy. Thus, their gain in performance at time 2 to 95% was not significant. In contrast, first grade students were performing at only a 77% accuracy level at time 1 on both the initial and final phoneme detection tasks. Thus, they were able to make significant gains on the final phoneme task and substantial (but nonsignificant) gains on the initial phoneme task.

The reason for a lack of significant gain on the initial phoneme task is not clear. According to the developmental progression hypothesis, one would expect children to make gains on initial phoneme detection at least as large as final phoneme detection if initial phoneme ability is developing first. Given that the children are only performing at 77% on initial phoneme at time 1, just as on final phoneme, the lack of significant gain cannot be interpreted as indicating that some level of mastery on the task precluded further improvement. It is possible that the greater gains on the final phoneme task as compared to the initial phoneme task were due to some type of instruction that stimulated progress. In fact, when the final phoneme task was introduced at time 2, some students remarked that they were learning those types of sounds in their class. Thus, children would be able to make greater gains on the task that had received explicit instruction than on the other tasks that had not been given instruction.

Differential Change in Phonological Awareness Skills: What Is Occurring?

The results of this study suggest that children develop some level of rhyme awareness prior to entering school and are able to increase their efficiency in detecting rhyme during kindergarten and first grade. The results also indicate that skills such as detecting initial phonemes and final phonemes are not as developed as rhyme awareness in children just starting school. Children appear to develop accuracy in these skills during kindergarten and first grade.

Why might this pattern describe the development of phonological skills? One reason may be the availability of rhymes in children's activities in comparison to other sounds. Bryant, Bradley, Maclean, and Crossland (1989) point out that rhymes are a frequent and heavily stressed part of nursery rhymes. It has also been shown that mothers recite nursery rhymes and sing lullabies to infants as young as three months, and do so with striking temporal regularities (Trevarthen, 1986, 1987, cited in Bryant et al., 1989). Thus, very young children may learn about rhyme through exposure to these traditional routines. In contrast, stressing final phonemes is not common in nursery rhymes and songs. Initial phonemes, though, are a regular part of nursery rhymes and songs in the form of alliteration. However, they are not as stressed or as

frequent as rhymes, and very young children may not be as sensitive to this unit of sound as the rime. Thus, exposure to rhymes may explain why many children appear to have rhyme sensitivity and may not have developed sensitivity to other sounds before attending school.

Another reason for the differential development of rhyme, initial phoneme, and final phoneme detection skills may lie in the nature of the cognitive demands of each skill. The development of each phonological awareness skill may be due, in part, to an increased ability to perform the cognitive processes underlying each. Yopp (1988) conducted a task analysis of various types of phonological awareness tasks in order to evaluate the cognitive demands of each task. The rhyme task in his task analysis was identical to the rhyme detection task used in this study. The word-to-word matching task in the Yopp study, in which a subject was required to decide whether two words begin or end with the same sound, conformed to the initial and final phoneme detection tasks in this study.

The task analysis revealed that the cognitive requirements of the rhyme task are: 1) hear the stimulus item, 2) hold the stimulus item in memory, 3) compare the two sounds or words, 4) make a judgment, and 5) respond yes or no. In contrast, word-to-word matching of either initial or final sounds require subjects to: 1) hear the stimulus item, 2) hold the stimulus item in memory, 3) perceive

separate sounds, 4) locate a given position, 5) identify sounds in a given position, 6) isolate a given sound, 7) hold a given sound in memory, 8) compare two sounds or words, 9) make a judgment, and 10) respond yes or no. The rhyme task shares all of its steps with only steps 1, 2, 8, 9 and 10 of the word-to-word matching task.

There are three main differences in cognitive requirements between the rhyme task and the word-to-word matching tasks. First, the rhyme task requires a more holistic judgment, while the initial and final phoneme tasks require more analytic judgment. In detecting similarities between initial or final sounds of words, subjects must perceive words as separate sounds to some degree and must be able to isolate the target sounds in order to compare them. In contrast, rhyme detection does not require any knowledge of words as separate sounds and does not require any isolation of sounds. The judgment can be based solely on the global perception of the word since the rime is the largest unit of the monosyllabic word. Morais et al. (1987) would agree with this notion. They contend that rhyme awareness may depend on sensitivity to phonological similarities without necessarily requiring analytic ability. The second difference is the load on verbal working memory. In the rhyme task, the child must hold the stimulus item in memory in order to make the comparison, but in the word-to-word matching tasks the child must hold the stimulus item in

memory as well as hold the isolated sounds in memory. Indeed, verbal short-term memory has been found to be related to phonological awareness skill (e.g., Mann & Liberman, 1984). The final difference between the two types of phonological awareness tasks is the number of steps to completion. The word-to-word matching tasks require several more steps to completion, making the task more complex and providing children with more areas of possible difficulties.

The ability to attend to the phonological structure of words may be another cognitive process that is required by initial and final phoneme but not by rhyme detection. Morais et al. (1987) mention a cognitive capacity underlying phoneme segmentation ability called "decentration." This term refers to the ability to focus attention on the phonological properties of speech while disregarding meaning. Given that the rhyme detection task may not require analytic judgment, this capacity may only apply to the initial and final phoneme tasks where students must identify sounds in a given position and isolate them in order to hold them in memory while making a judgment. Thus, a child's ability to decentrate may also be influencing his or her performance on the initial phoneme and final phoneme tasks. As an instance, during the final phoneme task at time 1 some children correctly responded NO to the stimulus pair "dog car," but remarked that the answer would be yes if the words were "dog cat." They were clearly attending to

the semantic feature of the words rather than the phonological.

Rhyme detection skills and initial and final phoneme detection skills may be developing at different rates due to the cognitive processes underlying these skills. The fewer and less complex cognitive processes required by the rhyme task may explain why children have reached a sufficient level of rhyme detection mastery at time 1 so that they did not improve noticeably in accuracy over test administration but did improve substantially in efficiency. In contrast, the greater cognitive demands of the initial and final phoneme tasks may have been the reason why children found these tasks difficult at time 1. Children may have improved their accuracy on these tasks over test administration due to increased short-term memory capacity, increased ability to attend to and isolate sounds, and/or increased metacognitive capabilities. As an instance of metacognitive development, many first grade students at time 2 began to spontaneously rehearse pairs of words before making their decisions in the initial and final phoneme tasks.

The cognitive requirements notion clearly accounts for the change in rhyme performance over time as compared to the other two tasks. However, it does not explain why children are performing about the same on initial and final phoneme detection tasks in terms of accuracy but not in terms of response time. According to the task analysis by Yopp

(1988), detecting whether two words are similar in beginning sounds or in end sounds requires the same processes and the same amount of steps to completion. In general, a child must isolate a given sound, then hold the resulting sound in memory while comparing the two word sounds.

Yet, isolating an initial phoneme should be easier than isolating a final phoneme. The reason is that initial phonemes that correspond to a single consonant (called single consonant onsets) represent a different linguistic level than final phonemes (Treiman & Zukowski, 1991). The initial phoneme is a salient unit of speech because it corresponds to the first segment of the onset-rime boundary of a syllable. Isolating a final phoneme, on the other hand, is more difficult because it is a constituent of the rime unit of a syllable and must be detected by segmenting the syllable into individual phonemes. In fact, the relative ease of initial phoneme detection as compared to final phoneme detection has been found in the performance of children as young as 4 years old (e.g., Treiman, 1985). It should be noted that initial phoneme detection is only easier than final phoneme detection when the initial phoneme corresponds exactly to the onset unit of speech. In words with consonant cluster onsets (e.g., trip) initial phoneme detection is not easier than final phoneme detection (e.g., Kirtley, Bryant, Maclean, & Bradley, 1989) because now it is a constituent of a larger unit of speech (i.e. the onset)

just as the final phoneme. Thus, the initial phoneme detection task in this study should be easier than final phoneme detection because initial consonant onsets are more accessible linguistic units than final phonemes. The greater accessibility of initial phonemes may explain why children were able to perform accurately and somewhat rapidly on the initial phoneme task, but were only able to achieve similar levels of accuracy on the final phoneme task at the expense of efficiency.

Phonological Awareness Development Requires Exposure to Sounds

Evidence for the developmental progression hypothesis has only been discussed in terms of the effects found for the mainstream students. Analyses performed on accuracy and RT measures in general do not indicate a developmental progression of phonological awareness skills for the TBE students. In fact, kindergarten students performed around chance level on all phonological awareness tasks at both time 1 and time 2, and first grade students performed around chance level at time 1 on both the initial and final phoneme tasks.

However, it appears that the TBE first grade students were improving their performance on phonological awareness tasks. In order to further examine whether TBE students were making gains, the performance of all TBE students on their native language phonological awareness tasks was

compared to the performance of mainstream students on their native language phonological awareness tasks. It was found that TBE first grade students made substantially greater gains on native language phonological awareness tasks than mainstream first grade students. Also, the TBE kindergarten students failed to make any gains on the phonological awareness tasks (with the possible exception of the initial phoneme task). In contrast, the mainstream kindergarten students made small gains (which were greater than those made by mainstream first grade students).

This pattern of performance can be interpreted within the framework of the developmental progression hypothesis. According to the developmental hypothesis, one would expect greater gains where skills have not yet been sufficiently mastered and smaller gains where skills have been developed. Thus, mainstream first grade students have gained the least because they had the most developed phonological awareness skills, and TBE first grade students have gained the most because they had the least developed skills (with the exception of TBE kindergarten children). As an instance of how poorly developed the skills of TBE first grade students were, TBE first grade performance on Spanish phonological awareness tasks at time 1 was not quite as high as mainstream kindergarten performance on their native language tasks.

The gains made by TBE first grade students may have been due to explicit instruction in phonological skills begun after the first phase of the study. As an instance, at time 2 when the experimenter asked students if they knew when two words rhymed, many gave examples like "camina, cocina," which they would not have learned from five minutes of instruction given by the experimenter at time 1 on monosyllabic rhyming words like "con, son." This observation supports previous findings that phonological awareness instruction improves subsequent phonological awareness performance (e.g., Lundberg et al., 1988).

One question remains: If the TBE kindergarten group had the least developed skills, why did they fail to improve their performance? According to the developmental hypothesis they should have made the most improvement. There are two possible explanations for the lack of improvement. First, TBE kindergarten students may not have been exposed to activities that would stimulate the development of knowledge of word sounds. Second, even if they had been given adequate experiences with word sounds, their skills may have been so impoverished that a 5-month period would not be enough to make an impact on their development.

The poorly developed phonological awareness skills of both kindergarten and first grade students at the outset of the study suggest that TBE students may not have had certain

types of exposure to the sounds of their language prior to entering school. Bradley et al. (1989) have remarked that nursery rhymes and word games, which play a large part in the interactions between parents and their young children, affect the development of phonological awareness skills. Further, Adams (1990) states that reading to a child is the best activity for developing interest in reading and developing prereading skills. However, Spanish-speaking parents have noted that it is nearly impossible to find Spanish children's books or other literacy materials in neighborhood markets, even in an area that is more than 90% Latino with many Latino businesses and grocery stores (Goldenberg, 1992). Thus, the relative scarcity of books in the homes of many Spanish-speaking U.S. families may be a reason for the lack of development of phonological awareness skills of Spanish-speaking TBE children.

Given that many Spanish-speaking children come from largely blue-collar, working-class families, their lower levels of phonological awareness may also be due to effects of socioeconomic status. The effect of socioeconomic status on reading readiness has been demonstrated in a study by Dickinson and Snow (1987) in which differences between kindergarten students from middle-class and working-class families were found on all prereading measures, including phonemic awareness.

Socioeconomic differences have generally been presented negatively in terms of opportunities that children are lacking or in terms of what parents fail to do. For example, parents of low-income families may not have the time, energy, and/or resources to give their children necessary experiences for phonological awareness development. According to this perspective, low-income children are often considered as having "deficient" readiness skills. Consequently, many professionals assume that they are "not ready" to learn about literacy (Goldenberg, 1992).

Snow (1991) provides an alternative way of interpreting social class differences. Her view suggests that middle-class parents provide qualitatively different literacy-facilitating interactions than lower-class parents. These types of interaction more closely match the approach that schools take. As an instance, middle-class parents typically engage in "literacy-contingent" behaviors such as answering questions about letter and number names, answering questions about words, reading aloud on request, and answering questions about pictures in books. Middle-class parents also make use of highly predictable routines like those found in alphabet books and Dr. Seuss and nursery rhyme books which exploit rhyme, rhythm, and alliteration. Because middle-class families interact with their children in ways that are similar to experiences found in school,

middle-class children become better prepared to learn to read. This perspective should not be interpreted as a fault of lower-income families, but merely a difference in interaction style that happens not to be reflected in schools. Thus, since these children come to school with a different type of exposure to language, they should not be seen as having "deficient" skills or as not being "ready" to learn about literacy.

In fact, it appears that Hispanic students from low-income families are able to successfully develop reading skills when given middle-class types of exposure to and practice with their language. For example, a study by Goldenberg (1992), which was conducted in a low-income urban community, involved providing kindergarten students with simple Spanish reading booklets and alphabet books, obtaining more parental involvement in the child's homework, and focusing some classroom time on learning the alphabet and discussing stories. Providing increased literacy-learning opportunities at home and in school clearly had a positive effect on the children's literacy development.

A specific reason for the lack of a clear developmental progression of phonological awareness skills in the TBE group is not known. Various sources have been implicated, such as lack of availability of native-language literacy materials and several possible effects of socioeconomic status. What is clear, however, is that the development of

phonological awareness skills depends on exposure to the sounds of one's language that is gained through early childhood experiences. If these experiences are not a part of the home environment, then making them a part of curriculum may be an alternative worth investigating.

Conclusions

This study has provided some evidence for a systematic developmental progression of phonological awareness skills. Various types of phonological awareness skills do not begin to emerge simultaneously. Instead, rhyme awareness appears to develop before other phonological awareness skills.

An orderly development of initial phoneme and final phoneme detection skills is not as clear from the results. However, the response time data give some indication that initial phoneme detection may be developing first. It is possible that assessment at a later point in time would reveal differences between these two skills. Indeed, one of the limitations of this study was the short length of time between test administrations. Another limitation of the study is the focus on only kindergarten and first grade students. Initial phoneme and final phoneme detection skills may be more differentiated in preschool children who presumably would have less exposure to and experience with print, and would therefore find initial phoneme detection much easier than final phoneme detection. In fact, this was the case in research by Treiman (1985) where preschool

children found detecting oddity in initial phonemes easier than in final phonemes. Future research on the development of phonological awareness skills may need to focus on various grade levels and levels of experience with print, and may need to track the children over longer periods of time.

This study has improved on previous research on phonological awareness by using response time as an additional measure of phonological awareness performance. The response time measure may be useful in determining developmental differences in the acquisition of a particular phonological awareness skill when accuracy performance on a certain task has already reached a ceiling, as in the rhyme performance of mainstream first grade students.

A developmental order of phonological awareness skills has potential for educational use. It suggests that beginning reading instruction may benefit children by introducing the correspondence between print and sound in a systematic fashion from rhymes to initial sounds to phonemes. A developmental order of phonological awareness skills may also offer valuable insight into the diagnosis and remediation of potential reading problems. Knowledge of the order of phonological awareness development would allow teachers to pinpoint a child's stage of development and to focus instruction on the specific skill needing further development.

APPENDICES

APPENDIX A

LIST OF STIMULI

	Rhyme: English	Rhyme: Spanish
Practice:	bat sat	con son
	tip den	ven las
	box fox	tan pan
Test:	nap red	dos par
	pig cot	mas ron
	can tan	ver ser
	hop mop	vez pez
	fun tap	sin col
	hid lid	mar dar
	tag boy	mes vid
	net wet	sed van
	dad sad	mal tal
	hen car	paz faz
	Initial Phoneme: English	Initial Phoneme: Spanish:
Practice:	cat cup	por paz
	fit rub	del sus
	bag win	sol pan
Test:	pan cut	ven vid
	bed tar	dar fin
	rat rip	les lar
	cop far	mal mis
	ham hot	fin col
	dog tap	ras lid
	man rib	cal coz
	pin pot	tal sur
	top tin	mes mar
	sun sip	son par
	Final Phoneme: English	Final Phoneme: Spanish
Practice:	bat hit	por lar
	dog car	tan mil
	pin hat	voz dan
Test:	red bad	con ven
	sat hot	mes cal
	lip run	luz ver
	leg pop	pan ten
	mom bus	tal vez
	sit dot	red vas

lap	dig
gun	pin
cut	pet
win	cat

tul	vil
par	sur
nos	del
ves	mas

APPENDIX B

CRITERIA FOR SELECTING STIMULI

The stimuli were constructed according to two criteria: 1) all words must contain three phonemes that correspond to letters in a consonant-vowel-consonant (CVC) pattern, and 2) pairs of words must share only the target sound or no sounds at all.

Three-letter words not conforming to the CVC pattern were not included. The reason was that initial sound detection in VCC words like "arm" and VVC words like "eat" would have been difficult. In addition, final sound detection in CCV words like "try" and CVV words like "pie" would have been difficult since their final sounds were equivalent to their rhymes.

Moreover, four-letter words were not likely candidates. Many four-letter words with four phonemes contain consonant clusters (e.g., "trip" and "hard"), which may have caused some confusion in determining the target sound in initial and final sound tasks. For example, in "trip" some may consider "t" the initial sound, but others may consider "tr" the initial sound. Many other four-letter words had three phonemes because they contain digraphs where two letters represent one sound (e.g., "book," "ship," "pass," "deer," and "hill"). Given that words have sometimes caused difficulty in phoneme segmentation tasks (breaking words up into individual sounds) when children have some knowledge of spelling patterns (e.g., Liberman, et al., 1977), there was a possibility that they would cause difficulty in initial and final phoneme detection tasks.

Of course, words not conforming to the 3-phoneme CVC criterion could have been used in only the tasks where they were appropriate. For example, three-letter two-phoneme words like "say" would have appeared only in the rhyme and initial sound tasks, and would have been excluded from the final sound task. However, to avoid any confounding between difficulty of tasks and types of words, it was beneficial to keep the type of word consistent across all tasks.

The rationale for using words that share only target sounds or none at all originated from related research conducted by Lenel and Cantor (1981). It was found that rhyme discrimination in a forced-choice rhyme task (e.g., lift: gift or list?) was significantly more difficult when the nonrhyming foil (e.g., list) shared more than one phoneme with the target word than when it shared one or zero phonemes. It was also found that the position of the common phoneme significantly affected difficulty. Given these findings, it was decided that the simplest condition be used in the sound detection tasks, in which pairs of words would have target phoneme(s) in common or zero phonemes in common. This would avoid making some pairs of words more difficult

than others by inadvertently including common phonemes other than the target phoneme.

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